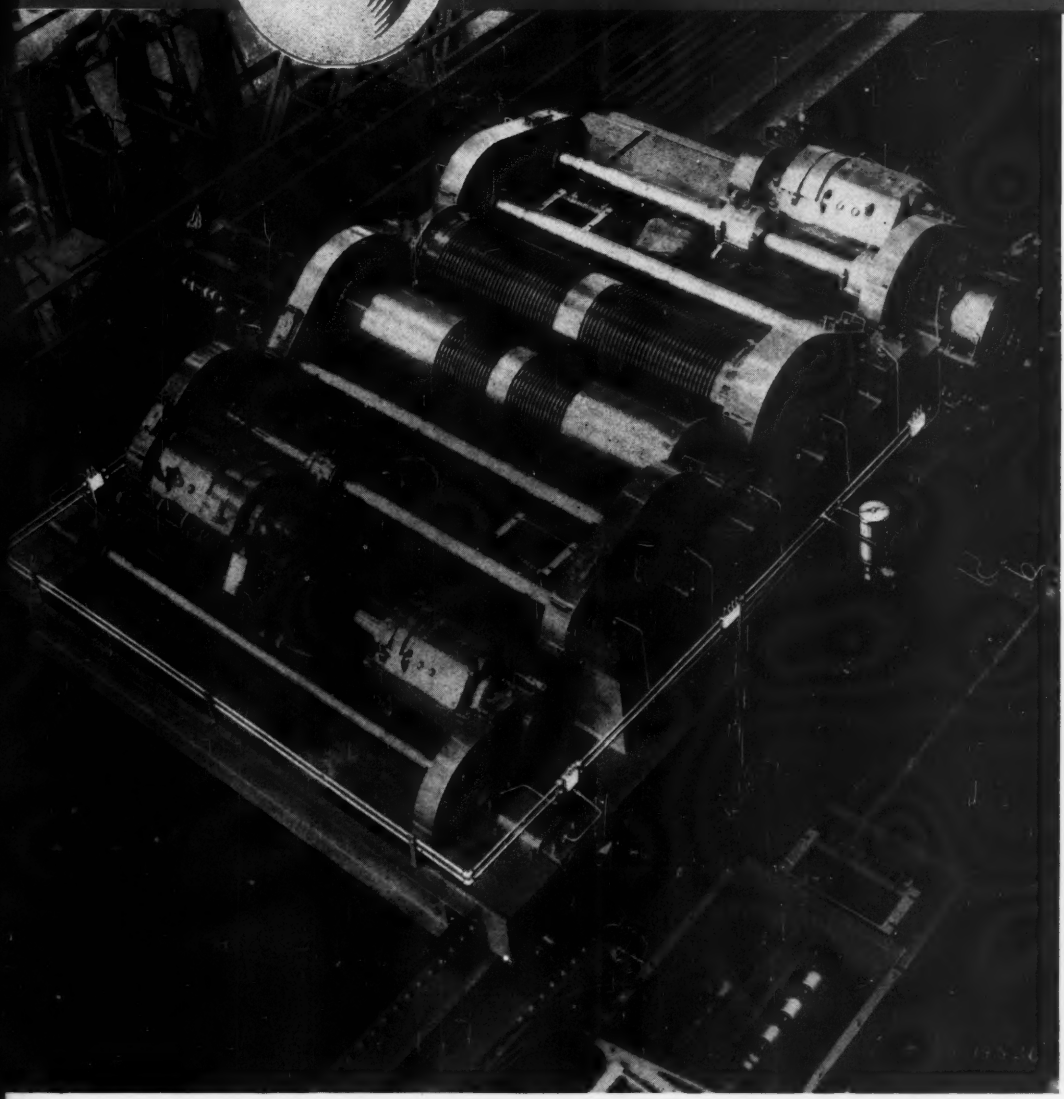
# Lubrication ENGINEERING



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Traveling Crane—Centralized Lubrication is Claimed to Have Many Advantages for This Type of Equipment—(See page 51)

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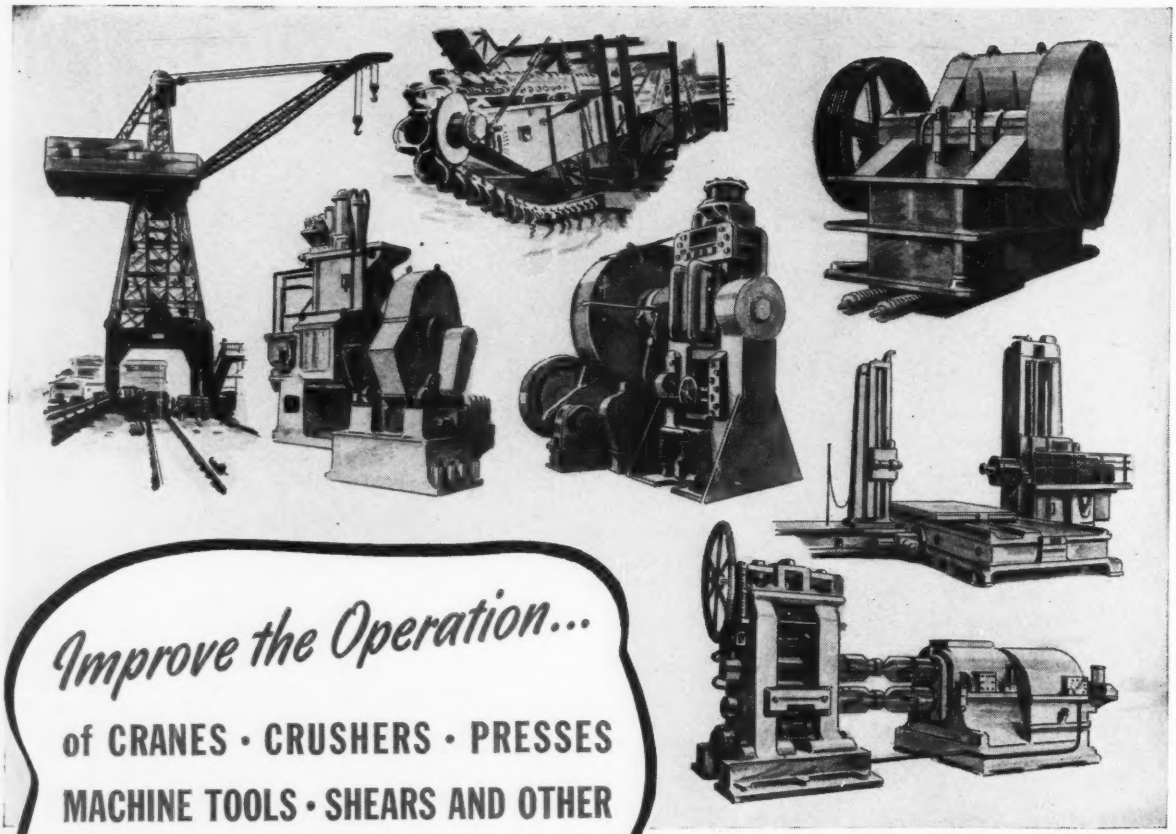

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**VOLUME 2**
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# Lubrication ENGINEERING

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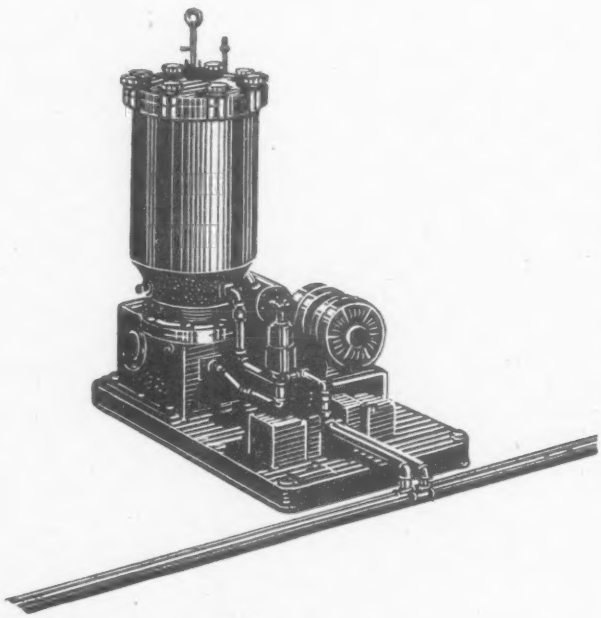

**FARVAL—*Studies in Centralized Lubrication* No. 78**

# Editorial

IT IS not the purpose of this editorial to stress the importance of Lubrication. I am sure we are all in agreement on that. There is, however, one aspect of the subject that must receive more attention if we are to achieve our aim of securing general recognition for the Lubrication Engineer.

The field of lubrication covers three divisions: research and development, manufacturing and distribution, and proper and systematic application. The first two divisions have been adequately covered and there are lubricants today to meet all the needs of industry. Developments are now under way in the laboratories to anticipate, and to keep pace with, future advanced requirements. Thus far we have produced lubricants; but we do not achieve the point of lubrication until we have actually placed these products between two metal surfaces to reduce friction.

The demands placed on the large war production plants in recent years brought out forcibly the necessity for scientifically planned lubrication. Speeds were stepped up, new machine processes developed which created an urgent need for more and better information on frictional control. Maintenance departments were on a twenty-four hour schedule and a large part of their work consisted of repair and replacement of machine parts, damaged from lack of lubrication. Gradually, in the larger plants, lubrication departments were organized to select and control application of all lubricants. Immediate results were obtained, and lubrication was established as an important phase of, and aid to, production.

It has been my privilege in the past few months to visit and inspect a large number of factories having from two to five hundred machine tools in operation, and with few exceptions, I have found very little appreciation of the true value and use of lubricants. In nine specific instances, when the subject was discussed, I was referred to the purchasing department. These men naturally had only a dollar approach to a problem which has been taxing the ingenuity of some of the most highly trained research chemists in a multi-million dollar business. Inspection revealed open containers, subject to every sort of contamination, and machine operators using their own judgment, with considerable variation in judgments and dry bearings accepted as a normal occurrence. This illustrates that "what's everybody's business is nobody's business". One Lubrication Engineer in that plant responsible for all lubricants, from platform delivery to bearing, would eliminate "Lubrication Failures". There is no such thing as "Faulty Lubrication". The bearing is either lubricated or it is not. We need men who will apply their mechanical knowledge to the important subject of lubrication, and when taught how, will know why. Only when Industry becomes aware of, and acts upon, this vital phase of production, will it realize how much additional profit will appear on the ledgers. In a recent case, during a time study of a machine operation on a production line, there occurred a bearing failure causing a shutdown for repairs. There is food for thought in this instance. Here is a loss in unit production for the operator thereby decreasing his earnings, and for management, interrupted machine productivity plus expense of time and materials involved. The manager of that plant might profitably consider a "time study" of lubrication.

In this Society, the first organized effort to obtain recognition for the profession of Lubrication Engineering, we have made great headway in uniting those interested in the subject. It is obvious that now we must take immediate steps to bring to the attention of Industrial Management the existence of a definite lubrication problem, in every plant, regardless of size, and to emphasize the importance of our work as a major contribution to efficient and uninterrupted production.

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# Centralized Lubrication*

By A. J. JENNINGS

*The Farval Corp., Cleveland, Ohio*

*This paper traces the history of centralized lubrication and describes some of the systems and devices in current use. Detailed descriptions of some types of application and the economies to be expected from them are given, including presses and forging machines, machine tools, rolling mills, and rubber mills.*

* * * * *

## Introduction

THE problem of frictional losses has been given a great deal of consideration in the design of modern machinery by the design engineer, the machinery builder, the bearing manufacturer, the lubricating system manufacturer, the lubricant supplier, and the lubrication engineer. All have combined their knowledge and experience with the result that the old time waste is being avoided, costs have been lowered and productive output increased.

We all recognize that continued operation of mechanical equipment depends upon its bearings, and that bearings in turn will operate only so long as they receive proper lubrication at regular intervals. It is doubtful, however, if all of us fully appreciate the difference between the kind of a job you get when all lubrication is turned over to a centralized system, as compared to leaving it in the hands of the human element.

In the first place, many plants in the past have had a crew of old timers on whom they could depend and who would take a personal pride in their knowledge and ability to keep the equipment operating. Today most plants are fortunate if they can retain one or two of their key men and therefore, they must rely for the most part on new and inexperienced crews who often have neither the knowledge nor the inclination to do a thorough job.

As a result of the tremendous expansion of plant equipment required to meet the productive demands of World War II, hundreds of our manufacturing plants have had a first hand experience with modern centralized lubricating equipment. They have had the experience of having new machines with centralized lubrication placed right along side of old equipment without it. They have also seen their old machines go down for lack of lubrication while the new units continue to turn out the products. This experience is being reflected in the increased demand on the machinery builder to provide a positive, dependable and complete system of centralized lubrication in his machines.

In a recent survey conducted by the magazine STEEL of the future markets for machine tool equipment, 85.6% of all users indicated they wanted centralized lubrication on their new tools, and in plants employing 500 people or more, the vote for centralized lubrication was nearly 94%.

## History

No discussion of centralized lubrication in the post-war period would be complete without touching on the history of lubricating methods in general and on the developments of centralized lubricating systems in particular.

We are all familiar with the old grease cups and oil cups but the first really modern equipment for the application of lubricant was the pressure gun and nipple used on the motor car chassis around about 1917 to 1918.

In spite of the very obvious advantage and convenience of the pressure gun and fitting, it was not until about 1922 or 1923 that this improvement came into use in industrial plants. The savings in lubricant, cleanliness, and better lubrication from the high pressure flushing action in the bearing, along with the improved quality of lubricants generally, led to the widespread use of this equipment in practically all manufacturing plants.

However, with this method it soon became apparent that many machines had to be shut down in order to lubricate their bearings and very few machines can wait until the next shutdown for their lubricant. Also any attempt to lubricate while operating involved the risk of injury to the oiler.

The next step in the development of this type of application, consisted of grouping the fittings or nipples at central stations accessible from the floor and running the individual tubes from each fitting to the bearing. Flexible hose connections were used to connect to moving points of application.

* *Presented at the First Spring Meeting of the American Society of Lubrication Engineers, Chicago, Illinois, April 5 & 6, 1946.*

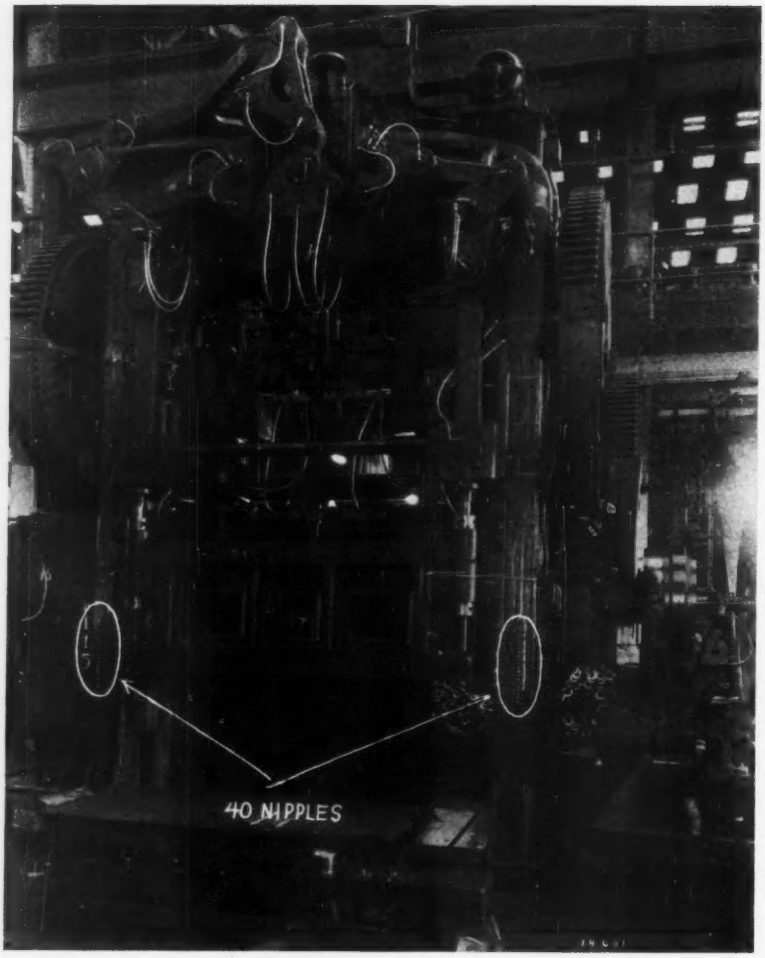


**Figure 1.**

This arrangement was the first big step in the right direction and is illustrated in Figure 1.

You will note that the greaser or oiler could connect to some 70 or 80 nipples on this press and lubricate all bearings without having to climb all over the machine, or shut it down in order to lubricate. The oiler had to learn through experience, however, about how much lubricant to give each bearing.

Thus it was necessary to depend upon the human element with no accurate control over the quantity of grease delivered to each bearing.

The bearings were not visible to the oiler when making the gun connection to the several fittings so some bearings received too much, some too little and some were missed entirely. In other words, there was no measuring valve for each bearing.

Along about this time also a variety of automatic pressure feeding grease cups were introduced, and broadly speaking, all were designed to provide a constant delivery of grease as long as the bearings were in operation. To attempt a complete description of each of these devices would require a rather extensive explanation, which would be of very doubtful value. I will, therefore, comment on but one of the more successful devices of this type as illustrated in Figure 2.

The spring on top of the large piston in this grease cup provides a source of constant pressure on the supply of grease and the screw threads in the pin, which is closely fitted in the outlet bore, offer resistance to the flow of lubricant from the outlet. As lubricant is slowly discharged from the cup, the pressure on the spring gradually becomes less, but at the same time the screw threads of the resistance pin are gradually passing out of the restricted bore, thus reducing the amount of resistance to the flow of lubricant. By this means resistance is reduced proportionately to the lowered spring pressure and a controlled constant rate of delivery is provided.

The constant pressure supplied by the spring, combined with a restricted orifice at the outlet, caused many of the greases used to bleed or separate the soap and oil. When this occurred the cup would load up with a cake of hard soap preventing further delivery to the bearing.

Most of the pressure feeding grease cups, therefore, required the use of a special lubricant. Special grease was required to insure proper operation of the device, regardless of whether it was suitable for the bearing or not.

Many of these grease cups performed an outstanding job on a few special applications, but when they were tried for universal application the limitations were apparent. However, over a period of time these devices have gradually found their own level and are being used successfully for specific applications where they are best adapted. As a matter of fact, no single lubricating device or system is best for all types of lubricant and all types of machine equipment.

Mechanical oil lubricators, for example, as shown in Figure 3, have been in use for 30 years or more and for some applications they are still the most satisfactory devices on the market. In the past many applications were made because there were no other types of mechanical lubricators available, but a considerable portion of this equipment today could be served better by a properly designed system of grease lubrication. Actually this type of device was originally designed for engine room lubrication rather than production machinery and it still fits engine

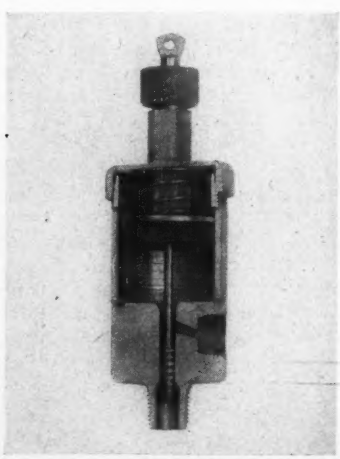

**Figure 2.**

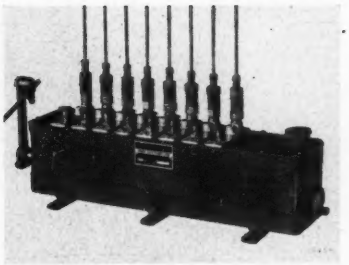

**Figure 3.**

room lubrication better than any other type of lubricator because it will handle oil only.

The high pressure gun and grease nipple as applied to the modern motor car have been the means of educating a great many people to the advantages resulting from the proper application of quality greases. They provide a quick, convenient method for delivery of clean grease to a bearing under high pressure and at the same time flush out most of the old lubricant.

They do not, however, provide an accurate control over the amount of lubricant delivered and there is no assurance that the oiler will always connect the gun to every grease fitting. This lack of control and dependence upon the human element led to the development of the centralized pressure system of grease lubrication.

As in the case of the grease gun and fitting, the early attempts at centralized systems were first made in the motor car chassis field and these systems were all of the so-called one-shot type. The earliest installation with which I am familiar is one that was put on a Hudson car in about 1922. Our original company made its first industrial installation in 1926 and, therefore, was one of the pioneers of this field.

Our modern, high speed, continuous production industries demand positive and regular lubrication with accurate control over the amount of lubricant required by all bearings. Any centralized system of lubrication, therefore, must provide for the positive delivery of a pre-determined quantity of lubricant to each bearing, regardless of the condition or location of the bearing, and this delivery must be made independently of all other bearings.

## Piston Displacement Principle

Without going into all of the many stages of development of the different systems, it is significant that every one of the successful grease systems now being offered, employs the piston displacement principle of measurement to control delivery of lubricant to each bearing.

The valve used to control the positive delivery of lubricant at the bearings is the most important single element in a centralized system of lubrication and, therefore, must be given first consideration in any discussion of a system for the proper application of industrial greases.

The piston displacement principle, which has had universal acceptance, obviously requires that a piston reciprocate in a cylinder to discharge a measured amount of lubricant with each operation.

The first positive piston displacement measuring valve was pressure operated in one direction, but spring operated in the other or on the return stroke.

Figure 4 depicts the heart of the first centralized system of 1926.

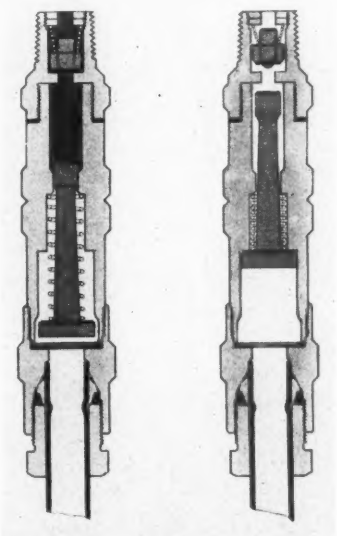

**Figure 4.**

Let's call it the Model "T" of centralized lubrication.

The limitation of this design is due to the fact that its successful operation depends upon a spring. The spring cannot return the piston to its original position until the pressure throughout the system has dropped low enough to permit the spring to overcome the static pressure remaining in the supply line. If the supply line extends beyond a rather limited distance, it becomes difficult and sometimes impossible to get proper relief of pressure throughout the length of the line. This is especially true with almost all greases excepting only the very light, soft grades. The spring controlled type of valve, therefore, is greatly restricted by being limited to the very soft greases only and, therefore, to bearings and machinery using this type of lubricant.

The spring actuated valve also operates to cause bleeding and separation of greases due to the pressing action of the piston on the return stroke, when it is working against the column of grease under static pressure in the supply line.

In general the use of springs and check valves constitutes an ever present hazard in any device employed for the application of industrial lubricants. Springs greatly restrict the selection of the proper grade and type of lubricant, and check valves are very susceptible to even small particles of dirt, foreign matter, or small lumps of soap base that might be contained in a grease.

## Hydraulic Measuring Valve

From the above it is obvious that a fully hydraulic lubricant measuring valve is preferable, particularly when it means the entire elimination of any mechanical connections, springs, check valves, or restricted ports and passages.

One type of hydraulically operated grease valve is illustrated in Figure 5. You will note that this structure provides for the reciprocating movement of the valve piston, by alternating the application of pressure on the lubricant in each of the two main supply lines, to which all valves are connected.

When pressure is applied to the lubricant in the line connected to the upper inlet connection, lubricant is directed into the top side of the main bore containing the large piston. The incoming lubricant moves

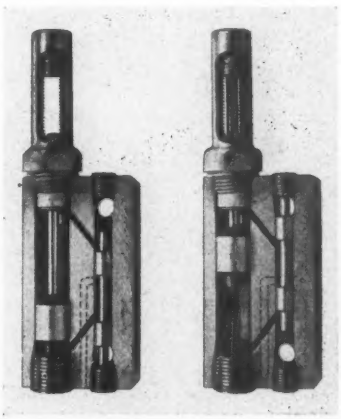

**Figure 5.**

the main piston down, to discharge a measured quantity through the valve outlet. The incoming lubricant on this operation fills the main chamber above the large piston.

When the top line is relieved of pressure and active pressure is applied to the lubricant in the line connected to the lower inlet connection, lubricant is directed into the lower side of the main bore causing the large piston to move upward. Upward movement of this piston ejects a measured quantity of lubricant through the valve outlet and this delivery continues until the large piston reaches the end of its stroke. The incoming lubricant on this operation fills the main chamber below the large piston and this charge of lubricant will in turn be delivered to the bearings when pressure is again applied to the upper inlet connection, as previously described.

This Dualine valve is adjustable for quantity and carries its own telltale indicator. It contains no springs, no check valves, has but two moving parts and will successfully distribute any type of pumpable grease or oil.

### The Complete System

Figure 6 illustrates a typical complete system layout with the manually operated central pumping unit and the two parallel supply lines, to which all measuring valves are connected. The grease measuring valves are located adjacent to the bearings they are to serve, with the short outlet connections from each valve chamber to its bearing.

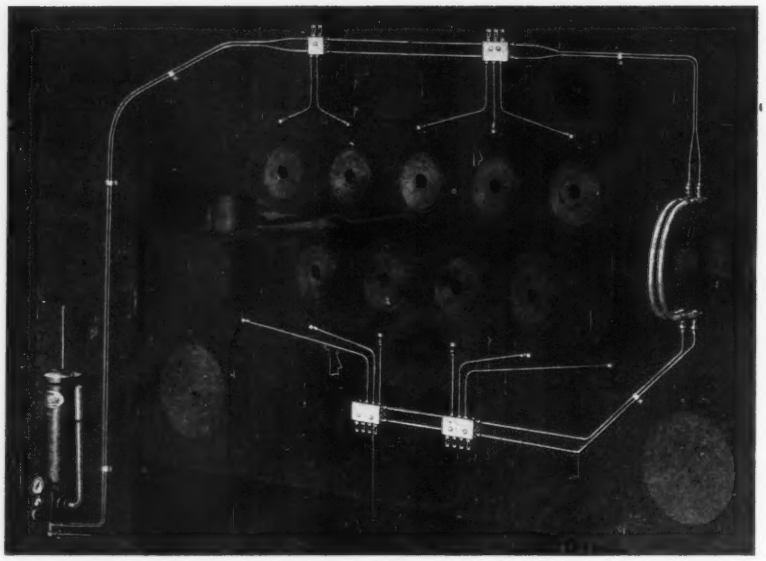

Figure 6.

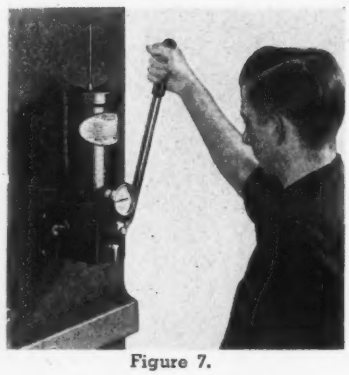

Figure 7.

Figure 7 shows one type of central pumping unit consisting of a manually operated plunger pump, a flow directing valve, a follower plate type of reservoir, and is complete with pressure gauge and fill connection.

A large majority of the centralized grease system installations consist of the simple manually operated unit. Complete lubrication of all bearings can be accomplished in less than one minute, and when one application every four hours will provide proper lubrication to the bearing, the more expensive full automatic system is not required.

Where conditions demand the renewal of lubricant at frequent intervals, the power driven automatic system with time clock control may be employed. This type of central pumping unit is illustrated in Figure 8. An electric time clock starts the motor driven pumping unit and after all grease measuring valves have operated, an additional pressure is built up at the end of the system in order to operate the flow reversing valve located at this point.

Operation of the flow reversing valve shuts off the pump motor, and ports one main supply line connection to relieve to the reservoir, while at the same time its also ports the outlet from the pump to the alternate main supply line. Therefore, when the clock again starts the pump motor, lubricant will be directed into the alternate main supply line leading to all lubricant measuring valves. This unit is also furnished with rotary drive for operation from a shaft on the machine be-

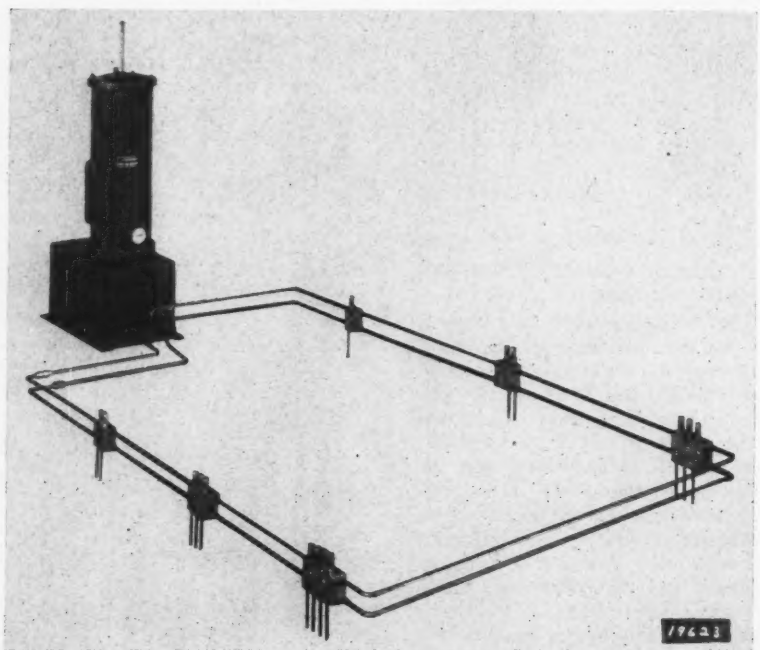

Figure 8.

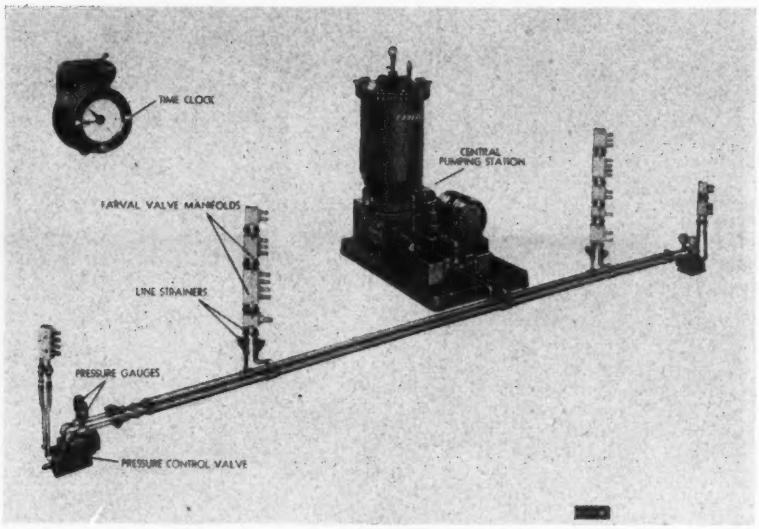


**Figure 9.**

ing lubricated and thus will start and stop with the machine it serves.

The large heavy duty automatic central pumping unit shown in Figure 9 will hold as much as 550 pounds of lubricant and was developed primarily for use on roll necks in the steel industry and for all types of rolling mill equipment. This type of system is being employed for the lubrication of the mills, tables, coilers, and conveyors, and it provides a positive, dependable method for lubricating a large number of bearings over a wide area from one central point. It is common practice to serve several hundred bearings by this method and on some installations as many as two thousand bearings are lubricated from one central unit. As a matter of fact, entire steel plants with 15,000 or 20,000 bearings are equipped with this type of centralized lubricating system, and including 300 to 400 systems of both manual and automatic types.

The automatic heavy duty unit is also being used extensively for the lubrication of rubber mills, calenders and mixers, and many complete plant installations have been made in this industry some of which involve several thousand bearings. Other applications include kilns, gold and tin dredges, forging machines, shell lathes, brick presses, group installations of metal stamping presses, etc.

## Pumpability of Greases

In considering the installation of any extended centralized system of grease lubrication such as is illustrated for the table roll bearings in Figure 10, careful consideration must be given to the pumpability of the lubricant to be distributed. It may be possible, for example, to pump a certain type of grease from the Stevens to the Palmer House but we all know you cannot pump it from there to Waukegan and somewhere between these points there is a practical maximum distance beyond which you cannot go.

In the first place, none of the standard mechanical or hydraulic handbooks contain any information or charts pertaining to the pumping of plastics or semi-fluid lubricants. All of the available information, therefore, has had to come from field installation experience with the various greases and from the tests that have been conducted by the system manufacturer plus those made by several of the lubricant suppliers.

In considering this problem there are four principal factors to be considered—the consistency of the lubricant—the rate of flow—the temperatures to be encountered — and the area to be served by the system. These factors determine the pipe size required to provide proper distribution without developing excessive pressures in the system.

Experience has shown that some lubricants will develop soap separation at higher pressures and in any event, excessive pressures should be avoided because they put an unnecessary strain on the piping and fittings, put an extra load on the pumping equipment, and of course consume power. Our field experience indicates it is desirable to have a maximum system pressure of no more than 1200 to 1500 psi. As it is desirable to have 600 to 700 psi available to deliver the lubricant to the bearings, the system piping should not offer a resistance of more than 700 or 800 psi.

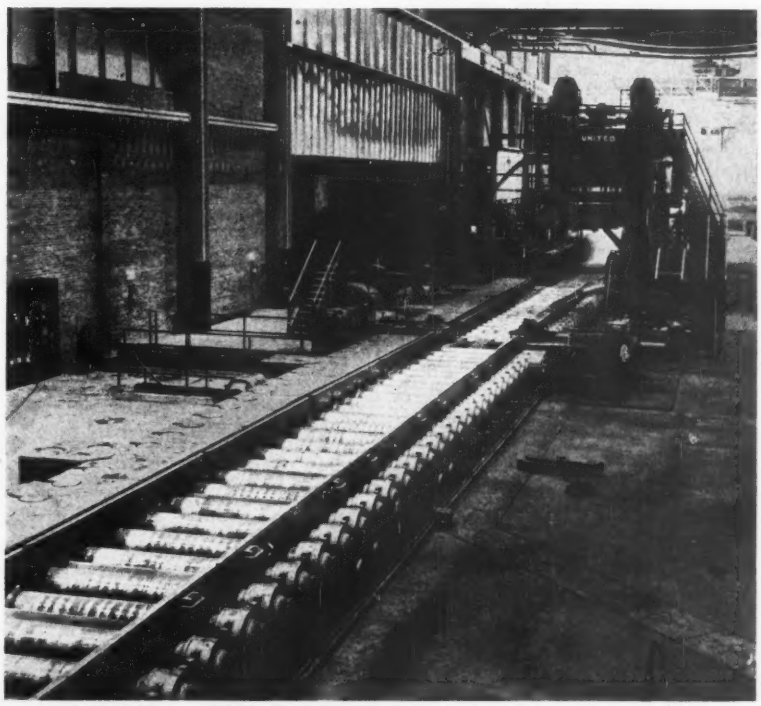

**Figure 10.**

Where lower temperatures are encountered, auxiliary heating may be necessary but when it is employed care must be taken to avoid overheating or cooking. For example, experience has shown that a steam tracer line laid parallel to the grease supply lines should not be permitted to come in direct contact with them, but that all heat transfer should be by radiation. Likewise, the steam and grease piping should not be covered with insulation or otherwise wrapped together or over-heating may occur.

Experience has indicated that to avoid any possibility of soap separation through over-heating, the temperatures should be held at 100 F or less.

Another very successful method for warming the main grease supply lines consists of the use of an electric hot bed cable wrapped around the grease piping and controlled by a thermostat. In this case, the piping should be covered with an insulating material as the thermostat will prevent excessive temperatures or overheating and by the same token the current consumption will be held to a very nominal amount.

The two methods outlined above for heating the grease supply lines have been found to be successful on Blast Furnace Tops and other outdoor installations.

Many very excellent low temperature greases that can be readily pumped without auxiliary heating have been developed in the past few years, and even with standard greases where temperatures do not go below 40 to 50 F no heating is necessary. With the run of mine variety of grease, however, where temperatures drop below 30 to 40 F, heating is normally required.

With experience to indicate that temperatures should not exceed 100 F and pressures per square inch should not exceed 1500 pounds, it was necessary to determine the resistance offered by the different greases when pumped at a given rate of flow through the standard pipe sizes.

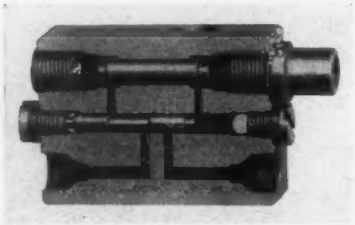

Figure 11.

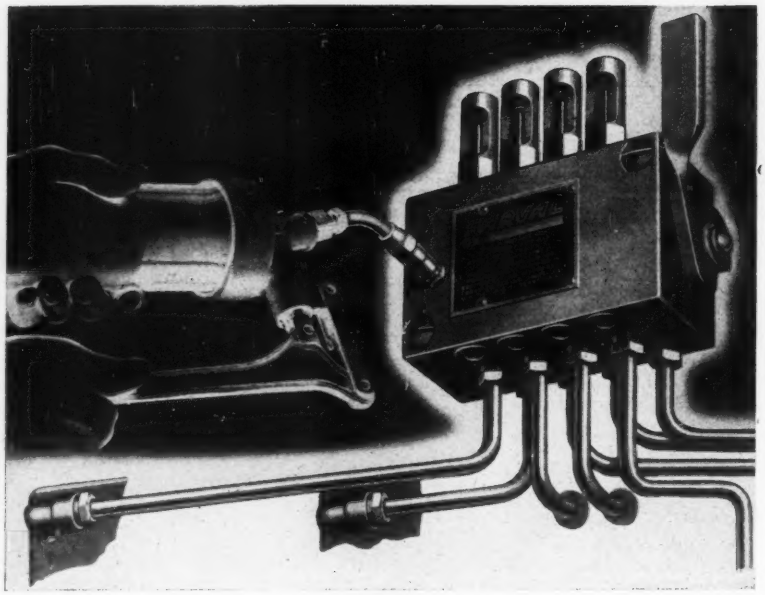

Figure 12.

Based on the records obtained from hundreds of field installations and combined with our tests of a wide variety of industrial lubricants, we have been able to prepare the following chart as a dependable guide for the selection of the proper pipe size and to determine the maximum permissible length of the supply lines.

| PIPE SIZE | PRESSURE DROP PER FT., PSI |
|---|---|
| 3/8" | 28.8 lbs. |
| 1/2" | 18.5 lbs. |
| 3/4" | 9.4 lbs. |
| 1" | 6.4 lbs. |
| 1 1/2" | 2.7 lbs. |
| 2" | 1.6 lbs. |

The above chart is based on pumping standard industrial lubricant having an ASTM worked penetration of 275 at 77 F at the rate of 10 oz. per minute and with the lubricant at a temperature of 60 F.

### System for Small Machines

In contrast to the heavy duty units, a small junior system as shown in Figure 11 is also available for smaller machine equipment. You will note this junior valve employs the same positive displacement principle of measurement as the larger valves, that it is free from springs or check valves, is fully adjustable for quantity and contains but two moving parts. This unit will distribute either oil or grease and is being employed for the lubrication of printing machinery, packaging machinery, wire forming machines, textile machines, glass and can machinery, and on may types of small machine tools.

The complete line of centralized equipment also includes the multiple measuring valve block shown in Figure 12. This unit is designed for use with any conventional type of portable grease gun, to serve a limited number of bearings where the complete system with its permanent central pumping unit would not be justified. From two to twelve bearings can be served from one block and the unit will handle either grease or oil. The stroke of each piston is adjustable to provide delivery of an exact amount of lubricant with each operation and there is a tell-tale indicator to show the job is done.

The multiple valve block in effect puts positive control between the oiler's grease gun and the bearing and permits him to lubricate several bearings from one gun connection. This unit is being widely used for the lubrication of the smaller inclinable and single crank presses and for lubricating isolated groups of bearings on many of the larger tools and equipment.

Figure 13 shows an application of the multiple measuring valve block to a Warner and Swasey turret lathe where the bearings on the individual sections of the machine are being served from the several valve groups.

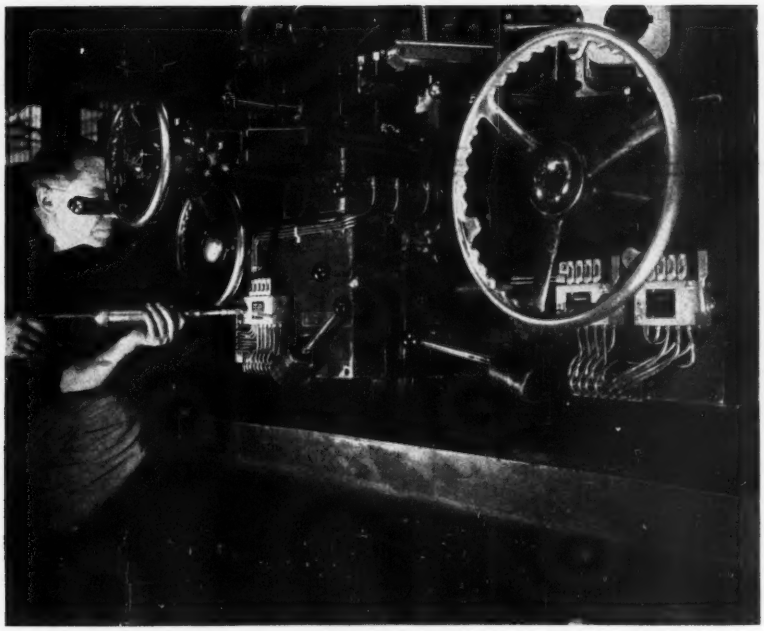

**Figure 13**

### Overhead Cranes*

An overhead travelling crane is one place where a centralized system of lubrication can perform a real service from the standpoint of safety, reduced maintenance, and continuity of operation.

The early installations were made primarily to provide safety for the oiler and to eliminate the hazard of a man climbing all over the cranes to reach each individual bearing. For example, an operator recently was killed when he slipped and fell while in the process of lubricating his crane. The man left a family behind and the accident resulted in an $18,000 compensation claim. This tragedy could have been prevented by a centralized system of lubrication.

These early installations soon revealed that better lubrication with the centralized system provided economies to more than justify the cost of its installation.

In the first place, a crane is overhead and no one can very well supervise its lubrication. When left to the individual, no one knows whether the crane has been lubricated or not until something goes wrong.

Many production shops today make certain that the bearings on machinery and equipment located at floor level are protected by some form of centralized lubrication. We believe you can appreciate how much more important it is to protect the bearings on the overhead equipment where supervisory control of the human element is not obtained.

The mills and metal working plants with broad experience with all types of bearings and methods of lubrication have found it is better to be able to lubricate all bearings on the bridge or trolley from one place and establish regular definite schedules for this job. They find that this practice insures that all bearings are lubricated regardless of their type or location and that they do not encounter maintenance delays, which in many cases have been reduced by as much as 50% through the installation of a centralized system.

We know of one case where roller bearing cranes were running on the same runway, some of which were equipped with centralized systems while others were not. After six months operation, the cranes without centralized lubrication were involved in delays for replacement of bearings. In one instance, the bearing replacement amounted to some $800 on two 30 ton cranes. There was nothing wrong with those bearings except that no one had time, or took the time, to go around and put fresh lubricant into them at regular intervals.

One of the crane builders recently made an observation that is both interesting and very much to the point. After they had put centralized lubrication on several cranes they were building, the head of this company stated he felt most crane users were engineering their crane specifications to the "Nth" degree electrically, but were overlooking the fact that they needed a centralized system to provide adequate lubrication to keep them running.

We might add that centralized lubrication is equally important to the continued operation of the old cranes and that a lot of people who provide lubrication for their new cranes overlook the value of it for the cranes they have in operation.

### Anti-Friction Bearings

Oil is generally considered to be the ideal lubricant for ball bearings, but it must be supplied in just the right amount and not too much or too little. If too much oil is supplied, heat is generated through churning and further, oil is difficult to keep from leaking out of the housing. Oil also presents the problem of leaving the bearings dry and exposed to rust when idle.

Therefore, while oil may be an ideal lubricant, it is very difficult to get a practical method of application without involving considerable expense.

For these reasons, most of the bearing manufacturers recommend the use of a soft, high-grade grease because it does not work out of the housing, will tend to seal the space between shaft and bearing, and also because at the higher speeds the rise in bearing temperature will be less than with oil.

Now some people feel that because a crane or any production machine is equipped with anti-friction bearings they need only be lubricated once a month or even once in two months. Who is going to remember to do this job, say every six weeks? And—when lubricating by hand, you have no control over how much or how little a man may put into a bearing. Usually it is too much because he wants to be relieved of the responsibility for not having given the bearings enough.

Anybody can lubricate a plain sleeve type bearing but an anti-friction bearing must not be over-lubricated and it must be given clean lubricant, all of which is assured through the closed centralized system which will deliver an accurately controlled amount to each bearing. The advent of the anti-friction bearing, therefore, has not eliminated the need for lubrication nor simplified the method of lubrication, but it has put it on a much more scientific basis.

* *See illustration on front cover.*

## Presses and Forging Machines

One of the earliest and probably the most generally accepted applications for centralized lubricating systems is on metal stamping presses as illustrated in Figure No. 15. Some installations were made as early as 1926 and a few years later it was not uncommon to find all presses in a department or even in an entire plant, equipped with centralized lubrication throughout. In 1929, our company made a complete plant installation consisting of 240 systems to serve between 5000 and 6000 bearings.

The large double crank and double action toggle presses offer the greatest opportunity for the maximum savings in labor, lubricant, and repairs, but the small presses can also show substantial economies through the use of centralized lubrication. Any piece of mechanical equipment that is down for bearing repair or replacement means lost production and sometimes the failure of but one bearing on one machine may shut down an entire department. Most of the press applications have consisted of the simple manually operated system.

The heavy duty forging machine shown in Figure 16 is equipped with an individual full automatic centralized system of oil lubrication, to provide the high pressure delivery of a measured charge to all bearings and slides at frequent and regular intervals.

This application is typical of those machines whose design, work load, and the conditions under which they must operate, require the frequent renewal of lubricant to insure continuous production. With the scale formed by the hot metal, header and die slides need the flushing action obtained from the frequent delivery of lubricant. The large diameter heavily loaded main eccentric bearing also requires regular renewal of lubricant especially in view of its somewhat narrow face width.

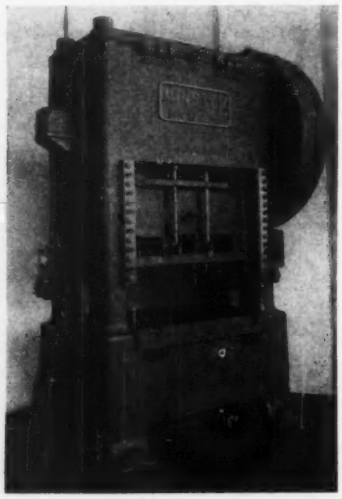

Figure 15.

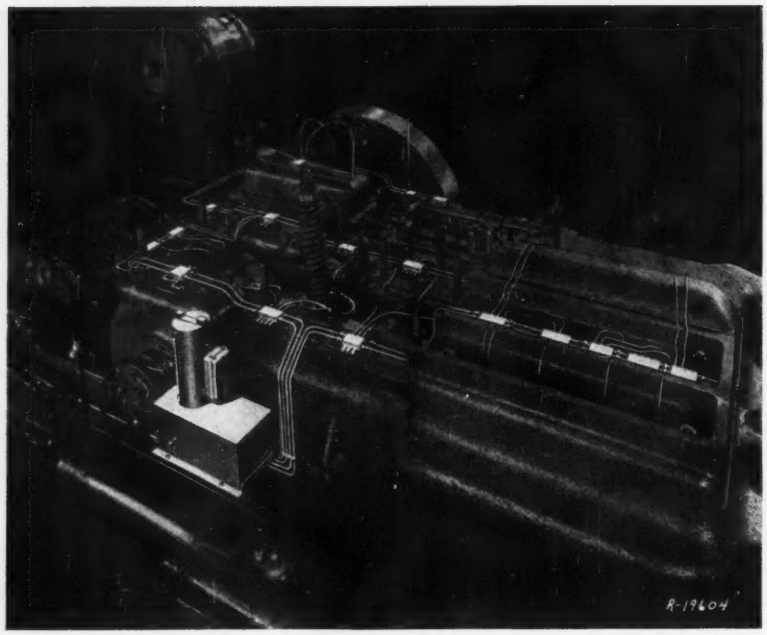


Figure 16.

In the past many forging machines were lubricated from a central reservoir with gravity feed to the bearings and slides, but in the past few years more and more of the machinery builders are changing over to the positive pressure delivery provided by a centralized system.

## Machine Tools

While a centralized system requires that lubricant be supplied at but one point—it is important to prevent the entry of dirt or foreign matter at this point, in order to provide delivery of clean lubricant from the barrel to the bearings. Figure 17 illustrates the convenient method employed to fill the individual pumping units on each machine, by means of the portable grease-pak with its length of flexible hose and quick fill connection.

The grease-pak is filled in the oil storage room from a barrel transfer pump and thus the lubricant is transferred from the original drum to the central system and finally to the bearings, without exposure to the air. In addition the pumping units of the central system are generally equipped with a filter or screen at the inlet fill connection to guard against carelessness on the part of the oiler.

In adopting centralized lubrication to high production machinery, the builder must provide in his design, for a built-in job that will be fully protected against accidental damage, in the normal operation or use of the machine. Figure 18 is an excellent example of this type of installation, in that in spite of the large number of bearings being served, the builder has made a neat, compact job of it, keeping the tubing in protected locations and yet leaving the lubricating systems fully accessible for any adjustment or attention required.

This special Horizontal Drum Type Indexing Production Machine was employed for taper reaming nozzle holes in 5" Rocket End Plates, at the rate of 100 pieces per hour. The system on the 34 Spindle Auxiliary Head and Travelling Carriage at the right, delivers a measured charge of oil to 36 points of lubrication including the bushings and

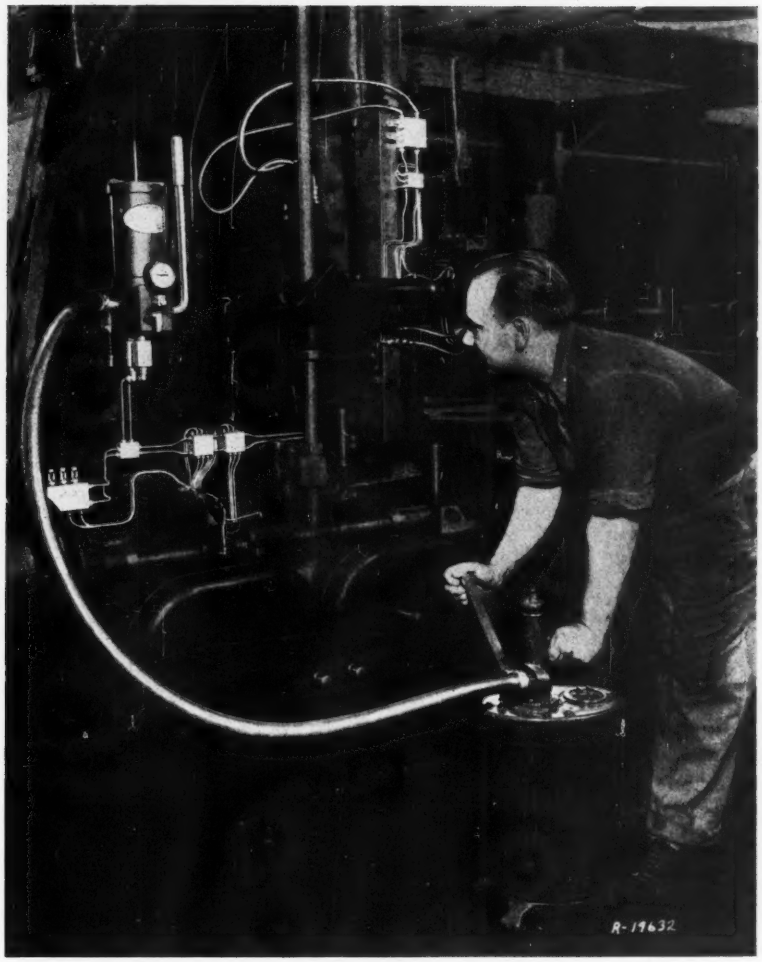


Figure 17.

the bearings and all moving parts.

Figure 19 shows a close-up view of the special sliding bushing plate with all bushings being served by a separate central oil system. The reader will note how the tubing leading to the many bushings has been kept out of the way of the tools and that it is securely and adequately clamped in place.

Another example of how a change in the design has made it possible to give complete lubrication of all points from a central system is illustrated in Figure 20. The upper view shows the four conventional nipples or fittings employed to lubricate the cylinder walls of air actuated plungers. Without a change in design, these points could not be served by a central system because the cylinder rotates and flexible connections would be impractical. From the lower view you will note that by lengthening the air channel through the piston rod and by means of cross drilled passages, combined with suitable grooving, all surfaces are lubricated through the oil that is injected into the air stream by the central system. A special atomizer quill through which the oil is fed is inserted in the air supply at the right.

## Rolling Mills

As mentioned earlier in this paper, centralized lubrication will provide outstanding savings when applied to old existing equipment and the results obtained on the 3-Hi Plate Mill shown in Figure 21 gives a good indication of what may be accomplished.

On the older equipment shutdowns for bearing repair or replacement following a production run are accepted as standard practice, and frequently the bearing and lubricant costs, power consumption, mill delays, etc., are considered to be a minimum normal figure. It is on this old equipment, however, where direct comparisons can be obtained and where perhaps the greatest opportunity for savings is offered.

On the mill shown in Figure 21, a set of top roll brasses had an average life of 20,000 tons before centralized lubrication was installed. After its installation, the life of these bearings was increased 25 times. The former average life of a set of bottom

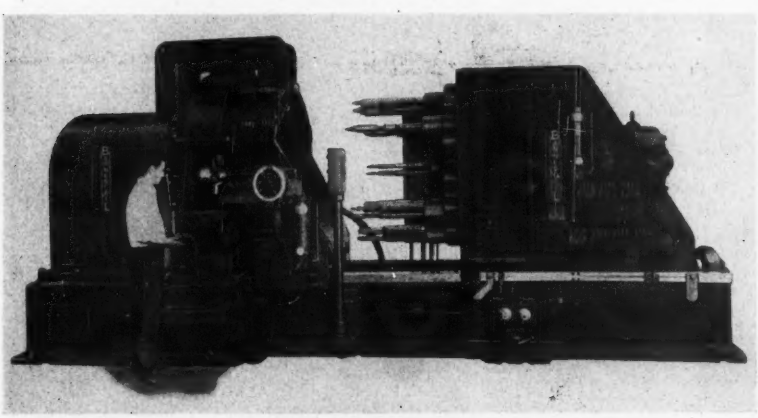

Figure 18.

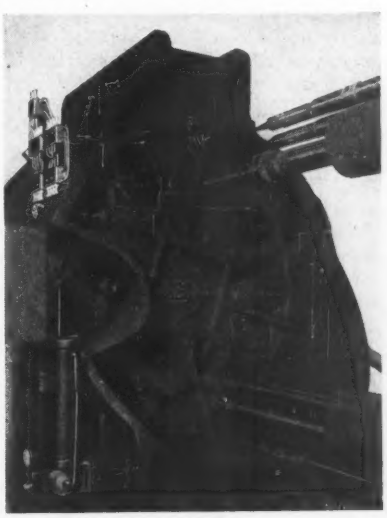

Figure 19.

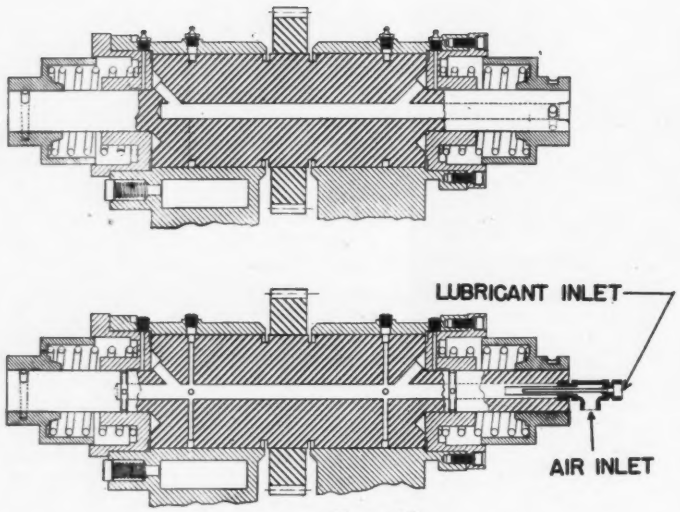


**Figure 20.**

roll bearings was about 40,000 tons and centralized lubrication has increased this figure to 180,000 tons. The shorter life of the bottom bearings can be charged to the presence of scale, although you will note the life has been increased some 4½ times its former average. These results were obtained using the same bearing materials and design, and with the same lubricant.

A set of four brasses weighs approximately 2400 pounds and the increased life gives a saving of more than 190 tons of bearing metal for the tonnage rolled. This saving is conservatively estimated at $15,000 per year.

In the past, hot and worn necks resulted in bad gauge variations, curved plates, and plates running into the necks. By eliminating worn necks and excessive bearing wear, centralized lubrication not alone cut down mill delays, but also cut the rejections due to these causes from the former average of 1½% down to .5%. On the basis of rolling 300 tons per turn, a saving of 1% amounts to approximately nine tons per day, which in turn means a saving at the $60.00 per ton selling price, of over $500.00 per day. These results were obtained from an original investment in the lubricating systems of less than $3,000.00.

### Rubber Mills

Centralized lubrication on rubber mill roll neck bearings also gives substantial savings in labor, lubricant, reduced maintenance and increased output. The group of rubber mills illustrated in Figure 22 is typical of the installations where one large heavy duty full automatic system is used to serve all of the mills, calenders, mixers, strainers, etc.

At one plant where 40 mills or more were equipped with centralized lubrication, they formerly employed eight oilers and after the installation needed but two. This resulted in reducing lubrication costs from $1400.00 to $400.00 per month. In addition, their former lubricant costs for one 60" mill using sight feed oil cups, was reduced from 24c for each eight-hour shift to 2c per mill per shift. A saving of 22c per shift or 66c per day per mill gave a total saving for all mills of $28.00 per day.

Notwithstanding the large savings made in labor and lubricant, this user states that the elimination of the former mill delays due to hot bearings has given them a greater saving through increased output than all the other economies combined. These results were obtained from an original investment in the lubricating systems of approximately $7,500.

First installations in the rubber industry were made some ten or twelve years ago and today centralized lubrication is being used on Refiners, Curing Presses, Banbury Mixers, Hose Wrapping Machines, Latex Machines, Conveyors, Rim Rollers and Expanders, etc. Practically all of the new plants that have been built in the past few years are equipped with centralized lubrication throughout. At one plant alone more than 200 rubber mills are being served by modern centralized systems of lubrication.

Similar economies to those outlined above could be reported for many other major industries such as coal, glass, cement, refractories, chemical, textile, and food.

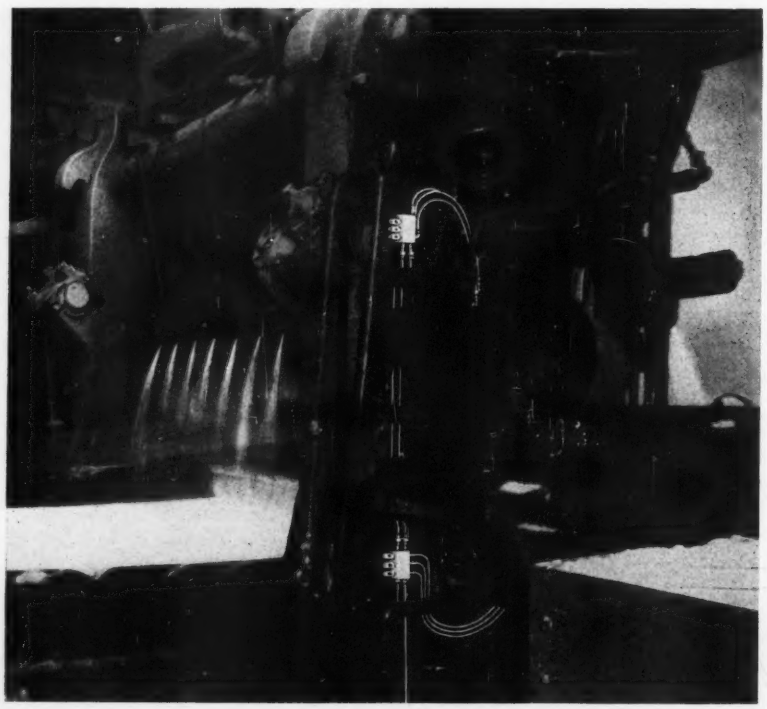

**Figure 21.→**

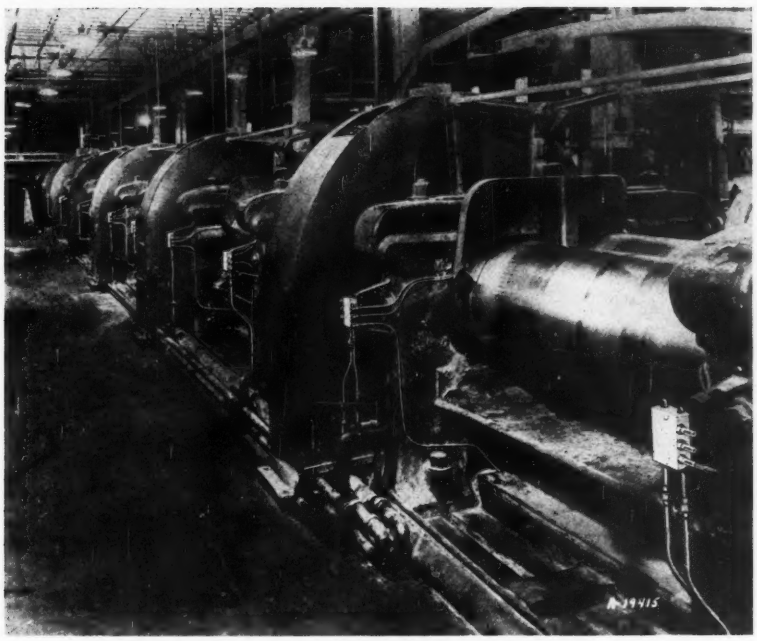

Figure 22.

### Conclusion

In normal times, experience has proven that it is pretty hard to depend on the human element to get around to the many bearings often enough to maintain a protective film of lubricant at all times. Under present conditions, centralized lubrication would seem to be the only hope of keeping a lot of bearings properly lubricated and keeping a lot of machines in continuous production. Certainly in the competitive, price-ceiling days that lie ahead, there will be no time for minor delays that add up to major shutdowns. Above all, there will be no time to lubricate by hand, or to repair the lack of lubrication.

The decision as to whether to install centralized lubrication on all equipment will depend on one of three alternatives.

(1) Hire enough oilers to get around often enough to keep all bearings properly lubricated at all times.

(2) If money isn't spent for oilers, it will be spent in maintenance and repairs and lost production.

(3) Spend the money once for a centralized system and it will continue to earn year after year.

Correct lubrication of industrial bearings requires careful consideration of each of the following factors:

(a) Selection of the proper bearing materials.

(b) Providing sufficient bearing area to support the load.

(c) Designing grooves correctly to insure proper distribution of lubricant.

(d) Protection with adequate seals where necessary.

(e) Selection of the proper kind and quality of lubricant for the bearing design and operating conditions.

(f) Providing a dependable means for the proper application of the right kind of lubricant at regular intervals.

These elements require the combined talents of the designer, the machinery builder, the lubricating engineer, the bearing manufacturer, the lubricating system manufacturer, and the lubricant supplier. It is to be hoped that the American Society of Lubrication Engineers may become the vehicle through which the full cooperation of all of them may be attained.

## Westinghouse Announces Grease For Ball and Roller Bearing Motors

For dependable lubrication from 13 F to 176 F for all speeds up to 3600 rpm and for horizontal or vertical operation, an improved grease for ball and roller bearing motors is announced by the Westinghouse Electric Corporation.

Available in a new eight ounce nasal type tube, the grease is said to be stable, highly resistant to oxidation, and will remain in a bearing for an indefinite period without drying out, caking or separating. The new tube is designed for easy and economical use. It has a large opening in the long nasal spout which fits into a one-eighth inch pipe coupling, and a key with which to wind and exert pressure from the bottom of the tube.

Further information on the grease may be secured from Box 868, Westinghouse Electric Corporation, 306 Fourth Avenue, Pittsburgh 30, Pa.

## New Oil Treating Equipment

Precision Processes, P. O. Box 301, Kansas City, Mo., offers engineering consulting services in connection with an improved line of *Precision Refiners,* custom built to refine, reclaim or filter many different types of oils.

The manufacturer claims that contaminated, diluted or used oils can be restored to original grade, quality and color at a cost of from 7 to 10 cents per gallon, with recovery ranging from 85 to 93 per cent, and that both volatile and solid contaminants are removed by the process.

The volatile impurities are removed by carefully controlled heating and agitation. A filtering compound is mixed with the oil and this mixture is agitated by compressed air and subjected to a temperature of between 300 and 500 F. The compound absorbs minute particles of carbon and other substances which discolor the oil.

*Precision Refiners* are said to require no special technical knowledge, since all operations are self-contained. The heating circuit is thermostatically controlled so that when the pre-set temperature is reached the heat is cut off. The oil is then forced by pressure through a screen and filter paper, leaving the filtering compound and all solid matter in the filter chamber.

# Characteristics of Typical Polar and Non-Polar Lubricant Additives Under Stick-Slip Conditions*

By M. EUGENE MERCHANT

*Physicist, Research Department,*
*The Cincinnati Milling Machine Co.*

*This paper advocates the use of lubricants containing chemically active polar type additives to minimize "chatter" occasionally experienced when slides and tables move on ways under conditions of light load and low speed. The apparatus used in making this study, and experimental results obtained are described.*

* * * * * * * * * * * * *

## Introduction

IN THE machine tool industry it is a well-known fact that slides and tables which must move on ways at very low speeds may occasionally exhibit a jumpy motion due to an alternate sticking and slipping of the sliding surfaces. This behavior is exhibited by both mechanically and hydraulically driven machines. It was early established that this condition could be prevented to some extent by suitable choice of a lubricant, but there appeared to be no general agreement as to the type of oil additives most suited to this service. Data on fundamentals were needed.

Beginning in 1939, Bowden[1] and his colleagues made a fairly extensive experimental study of the "stick-slip" phenomena, employing a resilient type of friction apparatus. Some attention was given to the effect of various pure liquids as lubricants, though not so much attention was paid to the behavior of additives in hydrocarbon oils.

In 1940, Blok[2] presented a theoretical analysis of the sliding process in which he pointed out that stick-slip behavior can be prevented not only by control of the friction conditions between the sliding surfaces, as by the use of a suitable lubricant, but also by controlling certain variables in the design of the mechanical system in which sliding is occurring. This fact had also been recognized and made use of in controlling stick-slip behavior on machine tools.† The design factors which influence the stick-slip behavior are as follows:

1. Mass of sliding body.
2. Modulus of rigidity of propelling mechanism.
3. Damping forces.
4. Sliding velocity.

## Apparatus and Principles

Bearing in mind the above factors, an experimental friction apparatus was designed and built in this laboratory to serve the dual purpose of testing slideway lubricants and obtaining some general information on the nature of the stick-slip process and the behavior of lubricant additives in controlling it. This simple apparatus was so designed as to exhibit, at low sliding speeds, marked stick-slip behavior of very low frequency in all cases except where the characteristics of the lubricant prevented such an occurrence. Its construction is represented schematically in Figure 1, while Figures 2 and 3 show the apparatus mounted on a milling machine which is used as a driving means. The apparatus consists of two flat cast iron (Meehanite) friction specimens (A and B) of surface dimensions 2″ x 4″ and 2″ x 8″ respectively, a driving mechanism (milling machine table, C) for moving the lower, longer specimen (B) at a desired rate, a horizontal yoke and calibrated spring (D) for holding the upper specimen with low rigidity in the direction of travel of the lower, and a vertical, calibrated compression spring (E) for applying a load to the surfaces. The amount of displacement of the upper specimen from its neutral position, under the action of the frictional force exerted on it by the lower specimen, is read by the dial indicator (F). It is evident that damping forces are negligible with this type of apparatus.

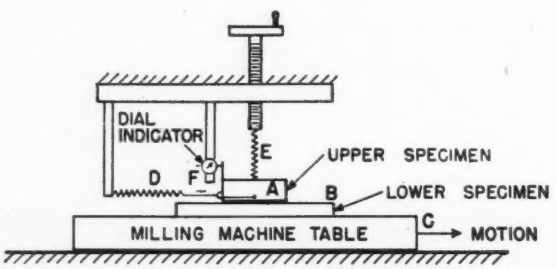


**Figure 1. Schematic Representation of Stick-slip Apparatus**

† *As covered in Research Dept. confidential report of Jan. 15, 1934 by A. H. Dall.*

* *Presented at the First Spring Meeting of the American Society of Lubrication Engineers, Chicago, Illinois, April 5 & 6, 1946.*

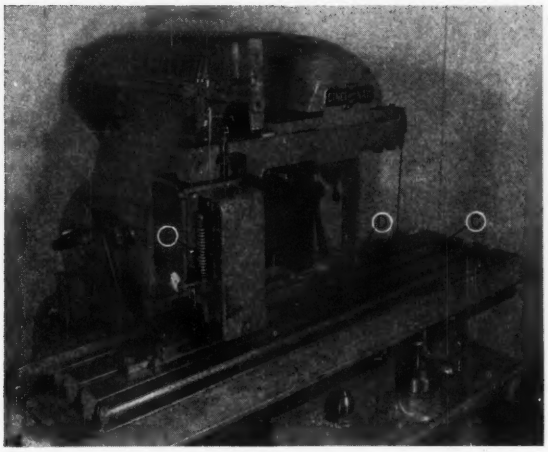

Figure 2. View of Stick-slip Apparatus Mounted on Milling Machine

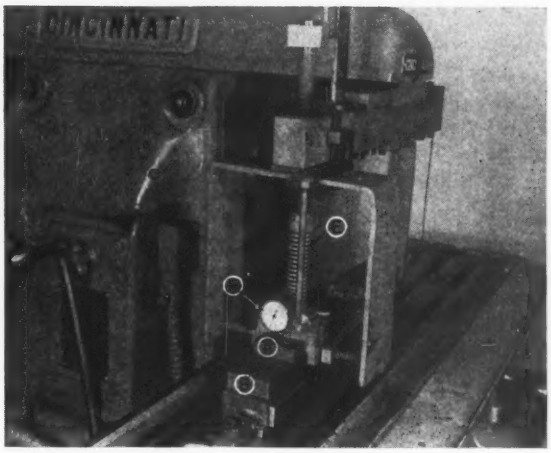

Figure 3. Close-up Showing Details of Stick-slip Apparatus

In operation the lower specimen is fed slowly in either direction by the milling machine table. The behavior resulting in the case where the static friction is less than the kinetic is illustrated schematically in Figure 4. The upper specimen will move with the lower until the force exerted by spring (D) equals the *kinetic* frictional force, at which point the upper specimen will come to and remain at rest. The reading of the dial indicator (F), together with the calibration for spring (D), then gives the value of the force of kinetic friction ($F_K$). To obtain the *static* friction, (B) is brought to rest by bringing the milling machine table to a stop. Specimen (A) then slides back a short distance toward the neutral position and again comes to rest. The force of static friction ($F_S$) can then be calculated from the indicator reading at that point.

The behavior of the apparatus in the case where the static friction is greater than the kinetic is illustrated schematically in Figure 5. Specimen (A) will travel with (B) up to the point at which the force exerted by (D) equals the *static* frictional force. At this point (A) will suddenly jump back toward the neutral position and come to rest at some position of lower force, after which the above process will repeat. This is the behavior known as stick-slip. It is evident that the force of static friction for this case can be computed from the indicator reading at the point at which return jump occurs (i.e., the point of maximum displacement from neutral). If the simplifying assumptions be made that the friction force drops instantaneously from the static value to a fixed kinetic value at the moment of initial slip between the specimens, and that this kinetic friction force is constant in value throughout the return jump, then the magnitude of that force can be calculated from the indicator reading corresponding to the midpoint of that jump, according to the following reasoning: When slip begins, the upper specimen (A) is accelerated by a constantly decreasing force, which is initially equal in magnitude to the difference between the static friction force and the kinetic friction force on the basis of the previously stated assumptions. As the spring (D) contracts, however, the upper specimen finally reaches a position where the spring force is equal to the kinetic friction force, and the acceleration force on (A) is zero. From this point on, the upper specimen is then decelerated by an ever increasing force, in a manner which is the exact opposite of the behavior during acceleration, until it finally comes to rest after having traveled through a distance ($\triangle L$) equal to twice that which it traveled to reach the point at which the spring force equaled the kinetic friction force. Thus the kinetic friction force corresponds to the spring force

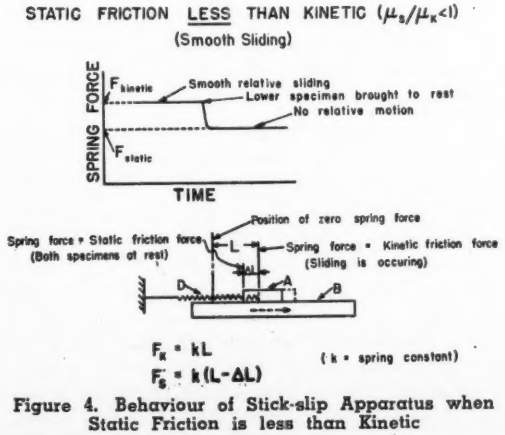


Figure 4. Behaviour of Stick-slip Apparatus when Static Friction is less than Kinetic

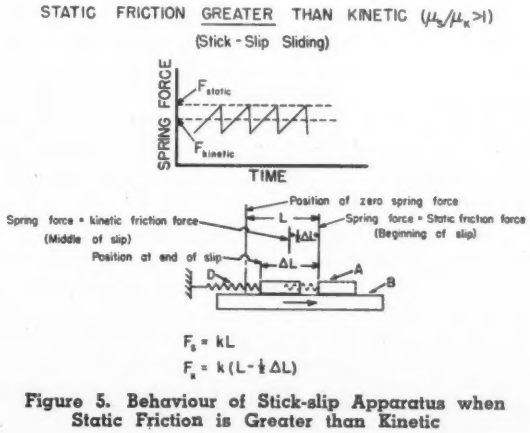


Figure 5. Behaviour of Stick-slip Apparatus when Static Friction is Greater than Kinetic

exerted on the upper specimen when it is at a point halfway along its path of slip.

The assumptions made above regarding the behavior of the kinetic friction force during slip are of course approximations, since that force is evidently not constant in value throughout the slip, but is, initially at least, dependent on sliding speed in some manner. However, Beare and Bowden[3] have shown that under conditions of dry or boundary lubricated friction the kinetic friction is independent of sliding speed down to *very* low values of speed. Thus the drop in friction force at the beginning of slip must be very rapid, and its rise at the end of slip almost equally rapid, so that the approximation ordinarily may be slight.

## Test Procedure

In obtaining the experimental data given in this paper, a fixed test procedure was employed. (A very similar procedure is employed in testing oils for their suitability as slideway lubricants, except that somewhat higher loads are used). The cast iron friction specimens used had a surface finish of approximately 200 mu-in., rms., produced by a planing operation. For each test the surfaces were first washed in naphtha, followed by scrubbing with pure benzene applied with cleaning tissues, thus removing the bulk of the oil remaining from previous tests, and leaving only the more tenacious of the adsorbed films. The specimens were then placed in the apparatus and run together dry under a load of 15 pounds, reciprocating at a speed of 120 in./min., to abrade the remaining adsorbed films, until the static coefficient of friction rose to a value between 0.4 and 0.5. The surfaces were in some cases flushed with pure benzene during this operation, where the previously established adsorbed films were particularly difficult to remove. In this case all traces of the benzene were allowed to evaporate before observing the static friction value. When the proper static friction value had been obtained by this procedure, the surfaces were separated slightly and the oil to be tested squirted between them with a clean medicine dropper. The specimens were then run together at a speed of 120 in/min. under a load of 15 pounds (1.88 psi. of apparent contact area) for 3 minutes, to give any active agents in the lubricant time to react thoroughly with the surfaces. Additional quantities of the lubricant were squirted on the relatively moving surfaces at one minute intervals throughout this running-in process. The surfaces were then stopped and additional oil was squirted between them. Then, using a rate of travel of ¾ in./min. for the lower specimen and a load of 15 pounds, the maximum and minimum values of displacement of the upper specimen from its neutral position were recorded. From these readings friction forces and the corresponding coefficients of friction were then calculated, using the formulas previously developed.

It is evident from the above descriptions of the apparatus and experimental procedure that in these tests the values of load and speed employed resulted in very mild boundary conditions, with the flash surface temperatures occurring during sliding remaining correspondingly low. This should be borne in mind in drawing conclusions from the experimental data presented later.

## Friction Tests on Typical Boundary Lubricants

In studying various lubricants with the apparatus, it was found that the necessary characteristic of an oil additive which is capable of preventing stick-slip is that it be able to produce a film of low shear strength solid material (ordinarily by chemical means) on the friction surfaces. The part which the shear strength of the material present at an interface between two bodies plays in the mechanism of friction has been previously demonstrated.[4] In the present tests, it was noted that there were two characteristically different types of additives capable of forming low shear strength solid films, and that the films produced also differed in type. These two types of additives may be generally classified by the terms "non-polar" and "polar." The *non-polar* type of additive is characterized by a relatively symmetrical inorganic or organic type of molecule which has little or no electric moment. Carbon tetrachloride is a typical example. The *polar* type of additive is characterized by an unsymmetrical organic molecule, usually of the long chain aliphatic type, having a large electric moment. Such molecules are strongly attracted to metal surfaces. Oleic acid is a typical example. Very often, the non-polar additives will produce non-polar surface films and the polar molecules will produce polar films. This is the case with the two additives mentioned above as typical, and is an important feature of their differing behavior, as will be discussed in more detail later. However, although the classifications "polar" and "non-polar" may also be applied to the surface films produced by lubricant additives as well as to the additives themselves, it does not follow that polar additives always produce polar films, nor non-polar additives non-polar films.

Boundary lubricant additives have also been classified by the terms "E.P. (extreme pressure) agents" as compared with "oiliness agents." The essential difference between these types lies in the nature of the surface films which they produce. The E.P. agent produces a film which is mainly inorganic in composition, while the oiliness agent produces a film which is mainly organic. Bowden, Gregory and Tabor[5] have shown that solid surface films fail as boundary lubricants at a temperature corresponding approximately to their melting point. Therefore the E.P. type of film will in general remain effective up to higher loads and rubbing speeds than will the oiliness type, since the melting points of inorganic materials are ordinarily higher than those of organic solids. The E.P. type of agent may be polar or non-polar, but the oiliness type of agent is ordinarily polar. In the case of the two additives mentioned above as typical, the carbon tetrachloride would be considered an E.P. agent and the oleic acid an oiliness agent.

In order to study the differences in behavior of non-polar and polar additives as stick-slip preventatives under the very mild conditions of load and rubbing speed afforded by our stick-slip apparatus, tests were made on carbon tetrachloride and oleic acid as additives to white paraffin oil. It should be noted, of course, that these two materials are not considered to be practical additives for use in machine lubricants, because of certain very evident disadvantages which are quite aside from their properties as friction reducing agents. They were chosen because they are simple liquid compounds typical of the classes of additives discussed above.

The white paraffin oil ued as the base oil in these tests was a laboratory grade similar to the medicinal type. It exhibited a molecular-weight of 337 as determined by cryoscopic methods, had a specific gravity of 0.864 at 77 F, a refractive index of 1.476 at 77 F, and a viscosity of 205 Saybolt seconds at 100 F. The carbon tetrachloride used was of C.P. grade and the oleic acid was U.S.P. Solutions of various molar proportions of the additives in the paraffin oil, varying from 100% paraffin oil to 100% additive, were made up and tested on the stick-slip apparatus using the test procedure previously outlined.

The results of the friction tests on carbon tetrachloride are shown in Figure 6. With the pure paraffin oil, the static friction is much greater than the kinetic, and marked stick-slip occurs. As carbon tetrachloride is added to the paraffin oil the static friction decreases linearly, while the kinetic friction remains unaffected. However, not until a concentration of approximately 77 molar per cent carbon tetrachloride is reached does the static friction become equal to the kinetic and begin to prevent stick-slip from occurring. At higher concentrations no stick-slip occurs, and the static friction decreases further, but at 100% carbon tetrachloride, the static friction is still relatively high. However, even if the static friction approached zero for pure carbon tetrachloride, it is evident that a very high concentration in the paraffin oil would still be required to prevent stick-slip, because of the linear nature of the friction curves. This is an evident disadvantage of the non-polar type of additive.

The mechanism by which carbon tetrachloride acts to reduce the friction between ferrous metals has been explained by Mougey and Almen[6] and elaborated on by others[4b]. Under the action of the contact pressures (and temperatures) the carbon tetrachloride reacts chemically with the iron surfaces to form iron chlorides and other products, most or all of which are normally solid at room temperature. These solid films, where they exist, prevent the metal-to-metal seizure which normally occurs at areas of high contact pressure when a liquid film only is present, and offer a film of solid material which has lower resistance to shear than the metal-to-metal bridges otherwise formed. Thus the force required to make one surface slide relative to the other is reduced.

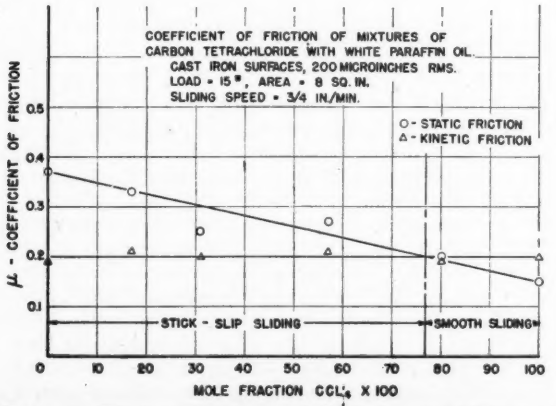
COEFFICIENT OF FRICTION OF MIXTURES OF
CARBON TETRACHLORIDE WITH WHITE PARAFFIN OIL.
CAST IRON SURFACES, 200 MICROINCHES RMS.
LOAD = 15#, AREA = 8 SQ. IN.
SLIDING SPEED = 3/4 IN./MIN.
O - STATIC FRICTION
Δ - KINETIC FRICTION
μ - COEFFICIENT OF FRICTION
STICK - SLIP SLIDING
SMOOTH SLIDING
MOLE FRACTION CCl4 X 100

**Figure 6. Effect on Friction and Stick-slip of Additions of Carbon Tetrachloride to Paraffin Oil**

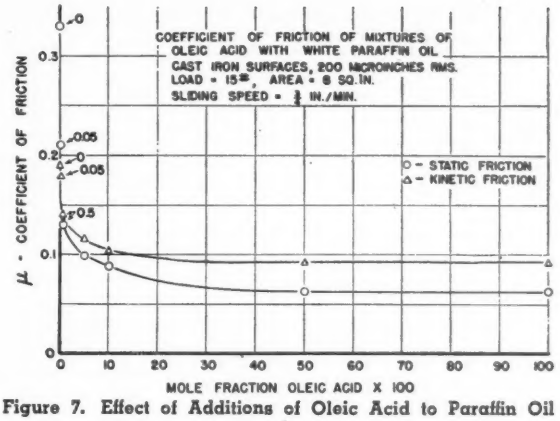
COEFFICIENT OF FRICTION OF MIXTURES OF
OLEIC ACID WITH WHITE PARAFFIN OIL
CAST IRON SURFACES, 200 MICROINCHES RMS.
LOAD = 15#, AREA = 8 SQ. IN.
SLIDING SPEED = 3/4 IN./MIN.
O - STATIC FRICTION
Δ - KINETIC FRICTION
μ - COEFFICIENT OF FRICTION
MOLE FRACTION OLEIC ACID X 100

**Figure 7. Effect of Additions of Oleic Acid to Paraffin Oil**

The linear nature of the static friction curve of Figure 6 can be attributed to the fact that, carbon tetrachloride being a non-polar molecule and paraffin oil also essentially non-polar, neither one is preferentially attracted to or adsorbed on a metallic surface. The concentration of carbon tetrachloride in paraffin oil at the iron friction surfaces is therefore practically the same as in the bulk of the solution. Thus carbon tetrachloride replaces paraffin oil on the surfaces, molecule for molecule, as the concentration of carbon tetrachloride is increased. The amount of friction-reducing protective solid film which is formed whenever actual contact pressure is applied to any tiny area of the surface is thus proportional to the relative concentration of carbon tetrachloride and paraffin oil on that area. Since the molecular concentration of carbon tetrachloride on the contact area is the same as in the bulk solution, the reduction in static friction is proportional to the bulk concentration. The fact that the kinetic friction is not reduced by the presence of the solid film suggests that semi-hydrodynamic conditions exist during sliding, so that the kinetic friction is governed mainly by the roughness of the iron surfaces. This appears to be characteristic of non-polar surface films.

The results of the friction tests on mixtures of oleic acid with the white paraffin oil are shown in Figure 7, while Figure 8 presents on an enlarged scale the be-

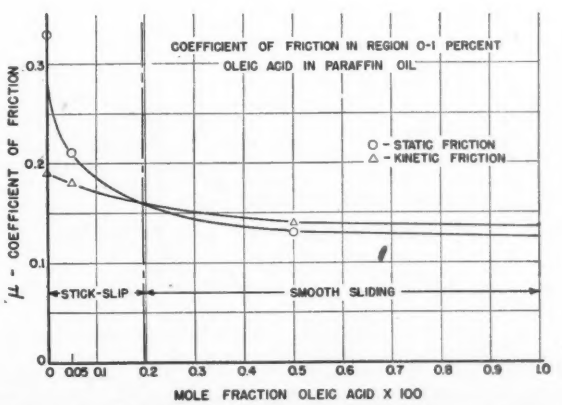
COEFFICIENT OF FRICTION IN REGION 0-1 PERCENT
OLEIC ACID IN PARAFFIN OIL
O - STATIC FRICTION
Δ - KINETIC FRICTION
μ - COEFFICIENT OF FRICTION
STICK-SLIP
SMOOTH SLIDING
MOLE FRACTION OLEIC ACID X 100

**Figure 8. Behaviour of Friction and Stick-slip in Range from 0-1 Molar Percent Oleic Acid in Paraffin Oil**

haviour of the curves in the region from 0 to 1 molar percent only. It is evident that these results are quite different from those observed on carbon tetrachloride. Both the static and kinetic friction drop very rapidly with initial additions of oleic acid to paraffin oil and then more slowly with further increments, until at concentrations above 20 molar percent the friction remains at practically constant values. It may be noted from Figure 8 that the static friction becomes equal to the kinetic at a concentration of only 0.2 molar percent oleic acid, so that for all higher concentrations stick-slip is effectively prevented, though it occurs at concentrations lower than 0.2 percent.

The above behaviour of the friction values may be attributed to the polar nature of the oleic acid molecule, which causes it to be preferentially adsorbed on metallic surfaces to the almost complete exclusion of the essentially non-polar paraffin oil. Thus the relative concentration of oleic acid in paraffin oil at the iron friction surfaces is very much higher than its concentration in the bulk solution. This is particularly true at low values of concentration of oleic acid in the bulk solution. Again the amount of protective friction-reducing solid film produced on any tiny surface area where actual contact pressure occurs is proportional to the relative concentration of oleic acid in paraffin oil on that area. In this case, however, since the molecular concentration of oleic acid on the contact area is much greater than in the bulk solution, the reduction in static friction is greater than would be predicted solely from the bulk concentration. The fact that the kinetic friction is also reduced by the presence of the oleate film suggests that the long aliphatic carbon chain of the latter is able to minimize the effects of surface roughness even under semi-hydrodynamic conditions. This appears to be characteristic of polar surface films.

The mechanism by which oleic acid acts to reduce the friction between ferrous metals has been shown by Bowden, Gregory and Tabor[5] to be due to the formation of iron oleate by reaction of the oleic acid with the iron surfaces. This product is a strongly polar, non-crystalline fatty solid, and therefore quite different from the simple non-polar crystalline solids formed in the case of carbon tetrachloride. Surface films of iron oleate offer considerably lower resistance to shear and have considerably greater adhesion for the metal surfaces than the surface films formed in the case of carbon tetrachloride. Therefore the former exhibit lower friction values and much greater durability under mild conditions than the latter, as evidenced by the data on friction already presented and the data on durability given in the next section.

### Durability of Boundary Films

Under the very mild conditions of load and speed provided by the stick-slip apparatus, a polar type of film such as produced by oleic acid has considerably greater durability than the non-polar type of film such as produced by carbon tetrachloride. This is illustrated by the data presented in Tables I and II.

TABLE I—LACK OF DURABILITY OF BOUNDARY FILM PRODUCED BY $C Cl_4$

| TREATMENT (Steps taken) | STATIC FRICTION COEFFICIENT $\mu_s$ | KINETIC FRICTION COEFFICIENT $\mu_k$ | $\frac{\mu_s}{\mu_k}$ |
|---|---|---|---|
| Surfaces wet with $C Cl_4$ | 0.19 | 0.22 | 0.9 |
| $C Cl_4$ evaporated and surfaces run together dry for 1½ min. at 15# load, 10 ft/min. | 0.38 | 0.32 | 1.2 |

From the data in Table I it is evident that the film produced by carbon tetrachloride had very little staying power in the absence of a supply of that additive, for when the carbon tetrachloride was evaporated from the surfaces and they were run together dry for a period of only 1½ minutes, the friction increased to a very high value and stick-slip occurred.

TABLE II—DURABILITY OF BOUNDARY FILM PRODUCED BY OLEIC ACID

| TREATMENT (Steps taken) | STATIC FRICTION COEFFICIENT $\mu_s$ | KINETIC FRICTION COEFFICIENT $\mu_k$ | $\frac{\mu_s}{\mu_k}$ |
|---|---|---|---|
| Surfaces wet with oleic acid | 0.08 | 0.10 | 0.8 |
| Surfaces wiped dry with clean cloth | 0.09 | 0.10 | 0.9 |
| Run dry at 10 ft/min. under various loads for a total of 16 min. | 0.06 | 0.08 | 0.7 |
| White paraffin oil applied | 0.09 | 0.11 | 0.8 |
| Run 6 min. with paraffin oil present | 0.10 | 0.11 | 0.9 |
| Run 3 min., flushing surface with paraffin oil at 30 second intervals | 0.12 | 0.13 | 0.9 |
| Same for an additional 3 min. at high load | 0.18 | 0.14 | 1.3 |

On the other hand, referring to the data in Table II, when all traces of liquid had been carefully wiped from the surfaces which had been run with oleic acid, using a very clean cloth, the friction was practically unaffected even after long running at high loads. Even when pure paraffin oil was applied and the surfaces run together, there was little change in friction. Only when the surfaces were flushed for a long period with paraffin oil, while running, was the film finally broken down enough to permit stick-slip to occur.

It should be pointed out that this excellent durability of the polar organic type of film can only be expected to manifest itself under mild rubbing conditions where the surface temperatures remain below the melting or softening temperatures of the solid surface films. As already pointed out, in cases where loads or speeds are high and surface temperatures correspondingly great, the solid inorganic type of film, such as that consisting of metallic chlorides or sulfides, may be expected to be more effective and durable, since it ordinarily has a considerably higher melting point than the polar organic type.

### General Observations on Commercial Lubricants

As already intimated, a large number of commercial lubricants have been tested with the stick-slip apparatus to determine their suitability, from the standpoint of friction and film durability, to serve as slide-way lubricants. Some general observations drawn from the data obtained in these tests may be of interest and are therefore given below:

1. For those lubricants which failed to prevent stick-slip from occurring (i.e. those for which the static friction was greater than the kinetic), the kinetic coefficient of friction was practically independent of the type or viscosity of the oil used, and was approximately equal to 0.18. In the case of those lubricants which were able effectively to prevent stick-slip, the kinetic friction was considerably less than 0.18. This is in agreement with the previously expressed conclusion that in the absence of a polar surface film the kinetic friction is mainly a function of properties of the test surfaces, such as their roughness, whereas long chain polar films are able to minimize the effects of surface properties on kinetic friction.

2. Ordinary hydraulic and engine oils gave very marked stick-slip, because of the absence of any appreciable amounts of active polar materials. However, the presence in a lubricant of additives containing sulfur or chlorine, even in fairly large percentages, gave no assurance that the stick-slip would be prevented, though it was usually reduced in magnitude by such oils. Because of the necessity for keeping the percentage of additives in a commercial lubricant to relatively low figures, only those oils containing chemically active *polar* materials were able to prevent stick-slip.
3. Those oils which were known to contain polar additives were able to prevent stick-slip even after the surfaces had been wiped dry, just as in the case of the oleic acid in Table II. This property suggests that under the mild conditions of slideway lubrication the polar oils should be able to prevent scoring of surfaces for extended periods in the event the lubricant supply is cut off.
4. Neither the static nor kinetic friction values bore any definite relation to the bulk viscosity of the oils for which they were observed.


### Summary

When mechanical conditions are favorable to the occurrence of stick-slip, it can be prevented only if the static friction be made less than the kinetic (i.e. friction must increase rather than decrease with increasing sliding speed, in the neighborhood of zero speed). This can best be done by establishing a film of *solid*, low shear strength material over a large percentage of the minute areas of actual contact of the sliding surfaces. While such a film might of course be applied mechanically or by electro-deposition, the best way to assure continued protection is by the use in the lubricant of an additive capable of producing and renewing such a film by chemical reaction when subjected to contact pressures. It has been demonstrated here that, under mild conditions of load and speed, a chemically active polar type of additive is much more effective, molecule for molecule, in preventing stick-slip than is a chemically active non-polar additive. Further, if a polar organic surface film is produced by the additive it will result in a greater reduction in friction and a more durable film, under mild conditions, than if a non-polar film is produced.

The practical conclusion from these findings, pertinent to cases where conditions of load and speed are mild, is as follows: In order economically and effectively to prevent stick-slip, reduce friction, and achieve film durability in the event of failure of the supply of lubricant, an additive should be employed which is polar in nature and capable of reacting chemically with metallic surfaces under the action of contact pressures to produce a solid film of low shear strength material which is also polar in nature. Of course, to be a practical lubricant, the oil must also be able to pass certain tests in regard to its stability, corrosiveness, etc., quite apart from its function as a boundary lubricant.



### Acknowledgments

The author wishes to acknowledge the helpful suggestions of Mr. Hans Ernst, Research Director, and Mr. Carl Graves, Research Engineer, in connection with the design of the stick-slip apparatus. The author has drawn on some of the findings of Mr. Albert Dall, Assistant Research Director, in analyzing the stick-slip process. The helpful assistance of Mr. Daniel Grieb of the Cimcool Division in obtaining and analyzing some of the data on commercial lubricants is acknowledged, as well as the assistance of Miss Jane Alexander of the Research Department in preparing the illustrations for the paper.


### Bibliography


[1]F. P. Bowden and L. Leben, *Proc. Roy. Soc. 169A*, 371-391 (1939); F. P. Bowden, L. Leben and D. Tabor, *Trans. Faraday Soc., 35*, 900-904 (1939); F. P. Bowden and L. Leben, *Phil. Trans. Roy. Soc. 239A*, 1-27 (1940).

[2]H. Blok, *S.A.E. Trans., 46*, 54-68 (1940).

[3]W. G. Beare and F. P. Bowden, *Phil. Trans. Roy. Soc., 234A*, 329-354 (1935).

[4]M. E. Merchant, *Journal App. Phys. 11*, 230 (1940); H. Ernst and M. E. Merchant, *Surface Treatment of Metals* (American Society for Metals, 1941), pp. 299-378.

[5]F. P. Bowden, J. N. Gregory and D. Tabor, *Nature, 156*, 97-101 (1945).

[6]H. C. Mougey and J. O. Almen, *Proc. Am. Petroleum Inst.*, Sec. III, 12th Annual Meeting, 76-81 (1931).


## Letters to the Editor

In his article on "Mechanism of Pour Point Depression of Oils by Additives," *Lubr. Eng.* 2, 11 (1946), Mr. Eugene Lieber quotes the writer as "claiming that the amount of wax precipitated can be calculated by Einstein's equation $\eta/\eta_1 = 1 + 2.5\,\phi$" and goes on to discuss the "shortcomings" of the equation as published in my paper, a shortcoming which was due to a typographical error only, in that the printer left out $\phi$, the volume fraction. This typographical error was so glaring, that the writer did not care to have an "erratum notice" about it printed in a subsequent issue.

As to the question of applicability of this equation to solidifying lubricating oils, it appears Mr. Lieber has misunderstood the paragraph (of the writer's paper in *Petroleum Refiner* 22, 287 (1943) in question. This follows for the purpose of clarification:

"It has been indicated above that the low-temperature viscosity consists of two parts; the viscosity of the fluid phase, and the viscosity increasing effect of the dispersed solid phase. If these solid particles would swim in the oil without touching each other, the ratio $\eta/\eta_0$ could approximately be related to the amount of precipitated wax by the Einstein formula $\eta/\eta_0 = 1 + 2.5\,\phi$ or one of its modified forms. A comparison of such viscosimetrically determined amounts of precipitate with the amount computed from heat of solidification data shows that the viscosity increase effected by the wax precipitate is, in almost all cases, very much greater than could be explained from the concentration of solid particles alone (Table 3). This can only be interpreted to mean that the precipitated wax crystals interlocked to form a structure the rigidity of which is measured by 'viscosity.' The amount $\eta/\eta_0 - 1 - 2.5\,\phi$ therefore indicates the resistance of that structure to shearing stress."

Very truly yours,

A. Bondi.

TABLE 3—The Structure Effect

| | 300 Visc. Medicinal White Oil Plus | | | |
|---|---|---|---|---|
| | .5% 52m.p. Paraffinwax | | .5% 52m.p. Ozokerite | |
| | As Is | +Paraflow | As Is | + Paraflow |
| Visc. @ 0C calc. from Einstein's equation ..... | 13.1 | 13.1 | 13.1 | 13.1 Poise |
| Visc. @ 0C experimentally... | 24.6 | 14.4 | 38 | 16.2 Poise |

# Surface Conditioning of Metals in Friction*

By PAUL W. WENDT

*Grafo Colloids Corporation*

*This article outlines the differences in the several grades or forms in which graphite is commercially available, and defines the special properties and applications of graphite in colloidal form, particularly its affinity for metal surfaces and its ability to remain in suspension.*

* * * * * * * *

IN these days of upward trends in compensation to labor, and increased cost of supplies for operation and maintenance, executive management in industry is relying on operating officials, maintenance supervisors, and lubrication engineers to offset these burdens as much as possible. Therefore, every avenue that may lead to increased production with present machinery should be explored. Also, greater economy in operation and maintenance is now expected.

Toward that end this paper has a twofold purpose, the first being to acquaint men of industry with an additive to lubricants, both oils and greases, which has a combination of inherent desirable characteristics not possessed by any other mineral, element or chemical, establishing this additive as outstandingly stable in resistance to dissipation by the various factors constituting the mechanism of wear.

The second purpose is to overcome prejudices which have been engendered by the misapplication of a product which, because it is available in several grades and types may have caused unjust condemnation of one of them under improper use.

Additives to oils and greases by refiners and compounders have of late years, by various means, tended considerably toward retarding wear phenomena in all kinds of machinery.

Thus, by expedients of inhibitors and detergents in lubricating oils, injurious factors such as oxidization, corrosion, and acidity are retarded greatly, and the deposition of deleterious foreign matter on metal parts of internal combustion engines is minimized. In greases there is a notable improvement in stability of the various compounds for general purposes, while extreme pressure characteristics in E. P. lubricants are steadily showing an upward curve in performance, due to new and more desirable additives.

The mechanism of wear is governed by various other influencing factors in addition to the above mentioned, most patent being those of scoring, galling, and seizing.

To combat these latter most apparent and objectionable factors, recourse has been made to the use of coatings for such specific parts in machinery as are considered the most sensitive to wear. As a result, there are today being used coatings of chrome, tin, lead, silicon, and zinc alloys, as well as various chemicals, all of which are applied either by electro-deposition or by mechanical application. The process method of precoating is no doubt the result of research in "Molecular Adhesion," by N. K. Adams[1] in which it was brought out that the presence of a desirable foreign substance between two mating parts practically negated the wedlock of the metallic surfaces.

This conclusion further substantiates the noteworthy axiom, "When possible, avoid putting two bare metal parts in contact in any assembly wherein wear is to be a factor."

There being available no ready published comparable data on the efficacy of the several elements, minerals, and chemicals now prevalently used as coatings and treatment for arresting the phenomena of wear, I respectfully bring to the attention of the members of this society the expediency of colloidal graphite when used for this purpose.

Graphite, as such, is generally well known for its ability to withstand disintegration at temperatures well above those of molten metals. Its use in molded form for various severe services such as in rings and seals in connection with transmission of various acids, establishes it as being chemically inert and resistant to most acids, various solvents, etc. Its self-lubricating properties are well exemplified by its use in clutch release bearings in automotive clutch assemblies, where proper lubrication is negligible or haphazard at best. These self-lubricating properties exemplify one of its desirable characteristics, low coefficient of friction.

It should be carefully noted there are several kinds of graphite, that most commonly in use being natural or mined, known as crystalline, foliated, or flake graphite. There is also synthetic electric furnace amorphous graphite, produced at temperatures over 5000 F. It is chemically pure by reason of its selected components and therefore free from abrasives. Both kinds are used in considerable quantities for many purposes.

* *Presented at the First Spring Meeting of the American Society of Lubricating Engineers, Chicago, Illinois, April 5 & 6, 1946.*

Colloidal graphite is that which is produced by a process termed "deflocculation," by means of which the particles are reduced in dimensions of 4 microns, down to submicron dimensions, in the shape of flat discs. The term "colloidal" is used as its designation to distinguish it from the powdered graphites, be the latter either mined or electric furnace amorphous products. By reason of the fact that deflocculated graphite particles are of such minute dimensions, they must of necessity be captured and contained in liquids. Dispersions in oil, water, castor oil, neutral spirits, and others are available for various specific purposes.

In the process of deflocculation, each particle acquires an electric charge. These charges being of the same sign, all particles tend to repel each other; consequently, they are in constant agitation. This distinctive characteristic is known as "Brownian Movement[2]", and the action accentuates adhesion under stress of induced friction or applied heat, while all powdered graphites are dormant, and therefore inactive in any mix.

Thus, do graphitic colloids enhance their affinity for metal, and a graphoid surface is obtained. Such a surface accelerates capillarity, because the low interfacial tension greatly facilitates the ready wetting of parts being served, and leaves a most tenacious oiliness on such parts, whether they be sliding or rolling in action.

It should be borne in mind that there is a decided demarcation in desirable functioning of the several graphites when used as additives to lubricants for surface coating purposes. Colloidal graphite is fully miscible, its particles remaining evenly diffused throughout the carrier medium for extended periods. Powdered graphites have a decided tendency to "settle out" readily when added to various liquid carriers, therefore have no tendency to provide a protective coating.

Furthermore, due to the molecular dimensions of the graphitic colloids, together with their repelling characteristics, and negligible proportion to the carrier, colloidal graphite will not "pack up," and therefore will not obstruct the passages in feed lines, nor clog up grooves, drilled holes, or other media expedient to the desired aim of proper lubrication to all parts. On the other hand, powdered graphites, due to their coarse particles, their lack of adsorption to metal surfaces and their inability to remain in solution, readily lend themselves to the very undesirable and costly consequences which have been encountered when used as an additive in liquid media. These adverse results are quickly evidenced when powdered graphite is used in connection with fine mechanisms, high speeds, and close tolerances.

Probably the fact that difference in particle size of a like substance changes its characteristics[3] is so little appreciated, is the greatest deterring factor in the general acceptance of colloidal graphite as a highly beneficial additive to lubricants. Therefore colloidal graphite must be disassociated from powdered graphites when considered in the light of desired results.

The benefits of a slip-plane graphoid surface on metals toward retarding wear phenomena have been gratifying to many in a greatly diversified industry. Not the least of those benefits are economy, and the simple facility by which all parts of machinery receiving lubrication, are protectively coated.

In conclusion, the fact should be stressed that the various dispersions before mentioned, are for a wide variety of applications. The percentage of colloidal graphite in each of the carrier mediums should vary according to specific applications.

### Bibliography


[1]N. K. Adam, *"Molecular Forces in Friction and Boundary Lubrication."*

*The Inst. Mech. Eng. Proceedings of the General Discussion on Lubrication and Lubricants* (London), October 1937, Group 4, P. 197.

[2]*Industrial Chemistry of Colloidal and Amphorous Materials.* McMillan Publishing Company 1942.

[3]J. M. Dallavalle, *"Micromeritics, Technology of Fine Particles."* Pitman Publishing Company 1943.


## Industrial and Scientific Technical Reports

The following reports dealing with lubricants and allied subjects are among those in *Index No. 1 of Available Industrial and Scientific Technical Reports,* published by the Office of the Publication Board of the Department of Commerce, Washington 25, D. C. Copies of these reports may be obtained by addressing the above office and department, and enclosing payment by check or money order payable to the Secretary of Commerce.

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# Potentiometric Determination of Acidity and Basicity In New and Used Petroleum Lubricants

## PART II*

By LOUIS LYKKEN

*Shell Development Company, Emeryville, California*

### Abstract

*Potentiometric methods for the determination of free and combined acidity have been found to be particularly applicable to highly colored or opaque materials such as used lubricants and lubricants containing oxidation and corrosion inhibitors, detergents, fats, and other additives, where acidimetric color indicator titrations fail. Although developed primarily for study of the oxidation characteristics of lubricating oils, the principles, apparatus, and procedures are applicable to many other materials such as asphalt, emulsions, resins, polymers, animal and vegetable fats, oils, and related materials.*

*Titration is made either directly or after saponification with potassium hydroxide in a single phase solution of the sample in nonaqueous solvent (benzene-isopropyl alcohol containing approximately 0.5% water) using a glass-calomel electrode system. Inflection points and fixed cell potentials are used to determine the end points.*

* * * * * * * *

All glass electrodes show a certain amount of error in measuring the pH of aqueous solutions or the cG of nonaqueous solutions, especially in alkaline solutions. This error is gradually increased by continued use in nonaqueous medium until the electrodes become undesirable for further use (Table III). It is because of such errors in measurements by the glass electrode that no two electrodes will give identical cG readings for a given solution of partially neutralized acids or bases in nonaqueous solution. Thus, some means must be used to apply a correction to the electrodes in order to determine accurately the important reference potentials, cG=0.236 and 0.650 volt. This correction is determined by testing with standard nonaqueous buffers[3], whose cG readings, on the basis of tests with ideal electrodes, are assumed to be standard for cG=0.236 and cG=0.650 volt. When the errors become so great that the electrodes will not reach the calculated value for cG=0.650 volt in the presence of a slight excess of strong base, they must be discarded; in fact, for best results the electrodes should be discarded if they will not give a higher reading than cG=0.700 volt.

TABLE III

COMPARISON OF NEW AND USED GLASS ELECTRODES
(Calomel electrode used as reference.)

| Test | New Glass Electrode | Average Glass Electrode | Borderline Glass Electrode | Unsatisfactory Glass Electrode |
|---|---|---|---|---|
| pH reading in pH 4.00 buffer | 4.00 | 4.00 | 4.00 | 4.00 |
| pH reading in pH 7.00 buffer | 7.02 | 7.03 | 7.05 | 7.05 |
| pH reading in pH 10.00 buffer | 9.95 | 9.79 | 9.28 | 8.83 |
| pH reading in pH 11.00 buffer | 10.76 | 10.53 | 10.03 | 9.37 |
| Maximum cG reading reached in free acid number blank, volt | 0.796 | 0.742 | 0.720 | 0.692 |
| Time required to attain maximum potential when immersed in benzene-isopropyl alcohol containing excess caustic, min. | 1 | 2.5 | 7 | 15 |
| cG reading in cG = 0.650 volt nonaqueous buffer solution, volt | 0.649 | 0.629 | 0.617 | 0.608 |

The continued use of the calomel electrode in nonaqueous solutions has no apparent effect upon its useful characteristics. If proper care is exercised in its preparation and maintenance, it should last indefinitely.

### *Titration Meter and Reflux Apparatus*

The titration meter used with the high-resistance glass electrode and a solvent of high electrical resistance must meet definite specifications for successful operations.[3] The "Dual AC Titrometer" (Catalog No. 8860) manufactured by the Precision Scientific Company, Chicago, Illinois, a unitized titration assembly including built-in titration stands, is recommended. The Beckman Model M (or Model O) pH meter, manufactured by the National Technical Laboratories, South Pasadena, California, is suitable if provided with a titration stand.[3]

For the refluxing required in the determination of combined acids and bases, the conventional Erlenmeyer flask and Allihn-type condenser are satisfactory but require that the longer double-titration (general) procedure always be used. For either the direct or double titration procedure an immersion-type condenser designed to fit the 250-ml. electrolytic beaker is more convenient. A complete refluxing unit is available from the Precision Scientific Company.

* *Part I of this paper appeared in the March, 1946, issue of LUBRICATION ENGINEERING.*

## Titration Solvent

To select a solvent satisfactory for this potentiometric procedure, extensive tests[5] of the solvents mentioned in the available literature, and of all others which might conceivably qualify, resulted in the choice of a 50% mixture of benzene and isopropyl alcohol containing a small amount of water. Subsequent tests showed that the optimum water content is 0.5%. The following properties of the solvents were considered: solvent action for heavy oil, equilibrium rate of electrodes in the solvent, electrical conductivity, inherent acidity, chemical stability, and nature of the inflection obtained. Table IV gives the results obtained for only a few typical solvents tested and evaluates them with respect to the more important properties considered.

Benzene-isopropyl alcohol is an excellent solvent for heavy oils, asphalts, and oxidized materials. Electrode equilibrium is rapid, inherent acidity low, and chemical stability good. The titration curves obtained give very good inflections. Anhydrous benzene-isopropyl alcohol has very poor electrical conductivity; however, the addition of 0.5% water increases the conductivity. With present-day electrical equipment, low conductivity of the solvent is not an important obstacle to its use.

The advantages of using a nonaqueous medium are illustrated by the graphs of Figure 3, which show six solvents ranging from benzene-isopropyl alcohol through the more water-like isopropyl, ethyl, and methyl alcohols, to water. The strong acid inflection is greatly improved by the nonaqueous medium, while the weak acid inflection although not as large as for water, is still very good.

Commercial isopropyl alcohol occasionally contains appreciable amounts of unsaturated material, aldehydes, or ketones, which on standing with excess potassium hydroxide form resins which color the alcohol yellow and cause interference in the determination of combined acidity (saponification number). The isopropyl alcohol used should develop no color on standing with solid potassium hydroxide, should contain less than 0.1% water by test, and should have low inherent acidity.

Commercial benzene generally contains saponifiable compounds of sulfur and chlorine which react more or less completely with potassium hydroxide. Since a great many factors can influence the rate of saponification of such compounds, considerable variation is obtained in the saponification numbers determined using commercial benzene even when blank determinations are made. Ordinary commercial benzene and isopropyl alcohol can be easily purified to meet specifications by refluxing over potassium hydroxide for several hours, and then carefully fractionating.

## Methods For Free and Combined Acid and Base Numbers

Since complete details of these methods are available elsewhere,[1,3] only a brief outline is included here. (It should be realized that the synopsis given here is for information only and not for use in making actual tests; the detailed ASTM procedures should be consulted before making any analyses.)

### *Electrode System*

The glass-calomel electrode system requires constant and regular attention to obtain reproducible values. After every titration the electrodes must be rinsed thoroughly first with benzene-isopropyl alcohol solvent and then with water, carefully dried with a clean towel, and soaked for a short time in distilled water. Special care must be taken in preparing the ground-glass sleeve of the calomel electrode.

Before use, the electrode pair is standardized with aqueous pH=4 buffer, and calibrated with two nonaqueous buffers (2), cG=0.650 and 0.236 volts. The constant $E_{GC}$ is calculated from the expression:

$$E_{GC}=E-0.236$$

where E is the voltage of the cell when immersed in pH=4 buffer.

### *Procedure for Free Acid (Acid Number) and Free Base (Base Number)*

#### *Free Acid*

Weigh or pipet a sample of less than 20 grams containing from 0.2 to 0.5 milliequivalent of acid into a tall-form 250-ml. electrolytic beaker, and 100 ml. of titration solvent, and adjust the beaker so that the electrodes are immersed in the solvent. Titrate with 0.1 N alcoholic potassium hydroxide, making certain that sufficient time is allowed for equilibration between increments of caustic. A satisfactory indication of equilibrium is a cell voltage "drift" of less than five millivolts per minute. Plot a graph of milliliters of potassium hydroxide as abscissas, and millivolts or pH scale readings as ordinates. Mark inflections that occur in the neighborhood of cG=0.236 and 0.650 volt (corresponding to pH scale readings of 4.0 and 11.0, respectively). Determine the number of milliliters required to each break. Make a blank titration following the above directions, but omitting the sample.

When the titration curve of the sample shows no definite inflection point, the number of milliliters of potassium hydroxide used to obtain cG readings of 0.236 and 0.650 volt are taken as equivalent to the amounts of strong and total acids, respectively. The voltages between the electrodes corresponding to cG=0.650 and 0.236 volt, as calculated using the constant $E_{GC}$, may be used as the correct values for any series

TABLE IV

ELECTROCHEMICAL CHARACTERISTICS OF VARIOUS SOLVENTS

| Solvent Composition | Water Added %v | Solvent Action for Heavy Oil | Equilibrium Rate of Electrodes | Electrical Conductivity | Chemical Stability of Solvent | Nature of Inflection Point (Acetic Acid) |
|---|---|---|---|---|---|---|
| Water | 100 | none | excellent | excellent | inert | good |
| Isopropyl Alcohol | 1 | poor | very good | fair | inert | excellent |
| Methyl Ethyl Ketone | none | good | slow | very good | reactive | fair |
| Chloroform | none | very good | slow | very good | reactive | good |
| Benzene | none | excellent | ——— | nil | ——— | ——— |
| Dioxane | 5 | good | slow | good | ——— | very poor |
| 50% Isopropyl Alcohol and 50% Isopropyl Ether | 0.8 | good | good | fair | reactive | excellent |
| 25% Isopropyl Alcohol and 75% Chloroform | none | very good | slow | fair | reactive | very poor |
| 50% Isopropyl Alcohol and 50% Benzene | 0.5 | excellent | good | fair | inert | excellent |

of determinations with a given electrode system. For work of a special nature or for cooperative or referee testing, the voltages corresponding to these cG values are obtained by calibration with standard nonaqueous buffer.

*Free Base*

Proceed exactly as for free acid, using 0.1 N hydrochloric acid instead of potassium hydroxide.

*Calculations for Free Acid and Free Base*

Figure 4 gives acid and base titration curves which illustrate the typical shapes commonly encountered and the manner of locating end points. The amount of base needed to neutralize the acids up to the first end point near cG=0.236 volt less the equivalent blank titration is a measure of the acid constituents with strong acid characteristics. The amount of base needed to neutralize the acids between the end points near cG=0.236 and 0.650 volt less the equivalent blank titration is a measure of the acid constituents with weak acid characteristics. Basic materials neutralized by hydrochloric acid above the end point near cG=0.650 are strong bases and those neutralized between the end points near cG=0.650 and 0.236 volt are weak bases.

*Procedure for Combined Acids and Bases (Saponification Number)*

Although the first procedure is the most general one, it is used only for samples of unknown saponification characteristics or for samples that upon saponification produce an adherent precipitate which clings to the surface of the reflux vessel. The simplifled direct titration procedure is generally preferred whenever it is applicable because it allows a considerable saving of time and manipulative effort.

*General Procedure*

Weigh or pipet a sample containing from 1 to 3 milliequivalents of combined acid or base into a suitable reflux vessel. Add boiling chips, 40 ml. of c.p. benzene, and 40+0.05 ml. of 0.2 N alcoholic potassium hydroxide. Reflux gently for 2 hours, remove from the hot plate, cool, and transfer the contents to a titration beaker. Adjust the beaker so that the electrodes are immersed in the solvent, and titrate with 0.2 N alcoholic hydrochloric acid as directed in the free base determination. Select the strong base and weak base end points in the same way as for free base (above). To recover caustic or weak bases left adhering to the walls of the reflux vessel, add 100 ml. of water, cover the vessel, and bring to a boil. Cool the water solution, transfer to a titration beaker, place the beaker upon the titration stand, and titrate with 0.2 N alcoholic hydrochloric acid. On the water titration curve, select the end points near the cG potentials of 0.49 and 0.30 volts (pH 8.2 and 5.0, respectively). Add the number of milliliters of hydrochloric acid required for the upper break in the aqueous titration curve to the number of milliliters required for the upper break in the nonaqueous titration curve, and the number of milliliters for the lower break in the aqueous titration curve to the corresponding number in the nonaqueous titration curve.

Make a blank determination using the above procedure, but omitting the sample.

*Direct Titration Procedure*

Carry out the determination as directed in the general procedure, but add sample, caustic, and benzene directly to the titration beaker, reflux in an apparatus with an immersion-type condenser, cool, and titrate directly in the reflux beaker.

*Calculations for Combined Acids and Bases*

Figure 5 gives typical combined acid-base titration curves which illustrate the shapes commonly encountered and the method of selecting end points. Where no definite breaks are obtained, the arbitrary points at which the cG potential is equal to 0.650 and 0.236 volt are selected as in the free acid procedure.

The difference in the amount of standard acid required to produce the end point near cG potential 0.650 volt (pH scale reading of 11.0) for the sample and the blank determinations is a measure of the amount of free and combined acidic constituents in the sample; this difference is equivalent to the customary saponification number. The difference in the amount of standard acid required to produce the end point near cG potential of 0.24 volt (pH scale reading of 4.0) for the sample and blank determinations is a measure of the free and combined strong acid constituents in the sample if the blank titration is greater than the sample titration; if the sample titration is greater than the blank titration, the difference between them is a measure of the basic constituents present in the sample. These relationships do not apply if the sample contains strong acids or bases, along with constituents that upon saponification produce bases or acids, respectively.

In those cases in which a water solution is prepared and titrated, the amount of standard acid used to produce an end point near cG potential of 0.485 volt (corresponding to pH 8.2) in the water solution titration is added to that required to produce an end point near a cG potential of 0.650 volt (corresponding to pH scale reading of 11.0) in the benzene-isopropyl alcohol solution titration. Similarly, the amount of standard acid used to produce an end point near cG potential of 0.295 volt (corresponding to pH 5.0) in the aqueous titration is added to that required to produce an end point near a cG potential of 0.236 volt (corresponding to pH scale reading of 4.0) in the nonaqueous titration. These sums are used to calculate the various differences and the calculations are then made as though only one titration curve had been obtained.

## Accuracy and Precision

The precision of the potentiometric methods depend upon the types of acids, bases, esters and soaps present, upon the general complexity of the free and combined acids and bases, and upon the materials associated with the reactive constituents. In general application to oxidized petroleum products, the precision obtainable is given in following tabulation (in terms of mg. KOH/g.):

*Good Inflection in Titration Curve:*

| FREE ACID OR BASE NUMBER | REPEATABILITY | REPRODUCIBILITY |
|---|---|---|
| 0.0 to 0.75 | 0.02 | 0.03 |
| 0.75 to 3.0 | 0.05 | 0.1 |
| 3.0 to 15.0 | 0.3 | 0.6 |
| 15.0 to 75.0 | 1.0 | 2.0 |
| 75.0 to 250.0 | 2.0 | 4.0 |
| **COMBINED ACID OR BASE NUMBER** | | |
| 0.0 to 5.0 | 0.06 | 0.12 |
| 5.0 to 30.0 | 0.2 | 0.4 |
| 30.0 to 225 | 1.0 | 2.0 |
| Over 225 | 2.0 | 4.0 |

*Poor Inflection in Titration Curve:*

The repeatability and reproducibility are generally twice that given for curves showing a good inflection.

The accuracy, which is generally of the same order of magnitude as the reproducibility, may be impaired by the nonreactivity of some acids or esters, and by the insolubility of some materials such as high molecular weight asphaltenes and polymers.

## Summary

Potentiometric methods for the determination of free and combined acids and bases in petroleum lubricants and similar materials are presented. These potentiometric methods furnish a reliable and reproducible means of quantitatively determining acidity and basicity in many cases where methods that depend upon color indicators fail because of the dark color and insolubility of the sample materials in water. In general, potentiometric results are more reproducible and reliable than those of color-indicator methods and, in addition, provide valuable information which serves to identify the acidic constituents present.

## Bibliography

A more detailed, general discussion has been given previously in the paper "Potentiometric Determination of Acidity in Highly Colored Materials," by Messrs. Lykken, Porter, Ruliffson, and Tuemmler, *Ind. Eng. Chem., Anal. Ed., 16,* 219-34 (1944).

[1] ASTM Standards on Petroleum Products and Lubricants, Report of Committee D-2, Appendix I, 1944.

[2] ASTM Standards on Petroleum Products and Lubricants, September, 1945, ASTM Designation D663-44T.

[3] ASTM Standards on Petroleum Products and Lubricants, September, 1945. ASTM Designation D664-44T.

[4] Larsen, R. G., Thorpe, E. R. and Armfield, F. A., *Ind. Eng. Chem., 34,* 183-93 (1942).

[5] Lykken, L., Porter, P. E., Ruliffson, H. D., and Tuemmler, F. D., *Ind. Eng. Chem., Anal. Ed., 16,* 219-34 (1944).

[6] Waters, G. and Burnham, H., *Ind. Eng. Chem., 36,* 263-271 (1944).

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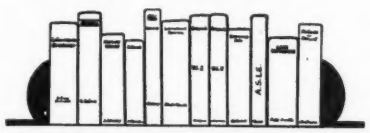

## REVIEWS OF CURRENT BOOKS

**RUBBER IN ENGINEERING—**

**Prepared under the direction of the Controller of Chemical Research of the Ministry of Supply and the Directors of Scientific Research of the Ministry of Aircraft Production and the Admiralty on the basis of research carried out by the Imperial Chemical Industries, Ltd.**

**Chemical Publishing Company, Inc., Brooklyn, N. Y.—1946. 267 Pages—Price, $5.50.**

The main purpose of this book is to furnish engineers with a general survey of the information now available on the fundamental properties of rubber. It is not intended as a practical guide but rather as an exposition of underlying principles.

The book is divided into four parts: I, the rubber-like state; II, the general properties of rubber; III, rubber technology; and IV, principles of the design of rubber engineering components. The first is a single chapter presenting the view that rubber is a transition state, intermediate between a solid and a liquid. For practical applications it is suggested that the elastic properties of rubber can be specified by three basic properties; tensile strength, resilience, and stiffness; and by twelve coefficients of change in these properties with temperature, frequency of stress fluctuation, stress and life. The second part consists of six chapters dealing with mechanical properties, stress and temperature, age and service, swelling, conductivity, and diffusion. The third has three chapters on: outline of rubber technology, compatability and incompatibility of properties, and bonding of rubber to metals. The five chapters of the last section deal with the factor of oil resistance in design and shape factor, shock absorption and vibration insulation, designing the rubber component, and specifications. There are 87 figures and 58 short tables.

Since much of the material presented is based on research carried out by the Imperial Chemical Industries, Ltd., one would expect to find some "propaganda" for the use of rubber. This is not the case, but on the contrary, the exposition is a fine example of studied restraint. Throughout the text care is taken to distinguish fact from theory. Practically every important statement is supported by reference to a table, chart, or published article. Over 300 authors are cited. Although the charts and tables have been well chosen and prepared, the reader is warned in the preface not to use data taken directly from them since their purpose is to illustrate a principle and the numerical values have no significance except insofar as they apply to one particular compound.

The authors' task in the preparation of this book is admittedly a great one, for the properties of rubber are unusual and poorly understood. They have chosen to describe it and its engineering applications as honestly, accurately, and completely as possible. A dull but useful handbook is the expected result, but the authors have produced a text which is interesting, smooth, simple and intelligible. The reviewer believes this book will not only be highly valuable to those interested in rubber, but will also set a new high standard for a general survey.

F. C. W. Olson,
Northwestern University.

The National Lubricating Grease Institute has recently released Technical Bulletin No. 6 concerned with the "Norma-Hoffmann Oxidation Test for Lubricating Greases." This publication should be of interest to all who are interested in grease tests.

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# OILS AND LUBRICANTS PATENT ABSTRACTS

**Lubrication System—Patent #2,394,437**—Walter R. Freeman, assignor to Wagner Electric Corp. In apparatus of the class described, a lubricant containing reservoir having a body of liquid lubricant therein subjected to fluid under varying degrees of pressure, a supply source of lubricant, conduit means for conducting lubricant from the source to the reservoir, said source being so arranged that the lubricant will be under the pressure at the point where the conduit enters the reservoir, and means associated with the conduit and the body of lubricant for maintaining said body at a substantially constant level, said means comprising a valve element, an axially movable valve receiving member arranged in a wall of the reservoir and a float so operatively associated with the valve element as to permit opening of the valve element when the lubricant falls below the constant level, said valve element being so arranged that the pressure of the lubricant in the conduit will act to unseat it and the fluid in the chamber when above the pressure of the lubricant in the conduit will act to hold it seated, said valve closed by pressure on the lubricant when the float is unable to close said valve.

**Lubricating Grease Composition—Patent #2,394,567**—Lorne W. Sproule and John C. Zimmer, assignors to Standard Oil Development Company. 10. A lubricating grease for the chassis parts of crawler-type tractors comprising a mineral lubricating oil having a viscosity of from about 150 to 200 seconds Saybolt at 210F, about 5% aluminum stearate, 0.75% of an alkylated mononuclear phenol, about 0.1% polybutene, the whole being worked into a homogeneous mass having a worked penetration at 77F of about 325.

12. Process for preparing an aluminum soap grease which comprises thoroughly mixing at an elevated temperature sufficient to effect substantially homogeneous blending a viscous mineral lubricating oil with at least 3% of an aluminum soap of a saturated fatty acid containing at least 10 carbon atoms per molecule and from about 0.25 to 1.5% of phenolic compound, and rapidly cooling the entire mass in bulk without agitation to a temperature below 140F.

**Lubricant Having High Film Strength — Patent #2,394,734**—John S. Yule, assignor to The Pure Oil Company. A lubricant having an S.A.E. load test above 300 pounds at 1000 rpm comprising a major quantity of mineral lubricating oil and a minor quantity of sulfo-chlorinated and phosphorized fatty body selected from the group consisting of animal, vegetable and marine fats, oils, and waxes, which sulfo-chlorinated fatty body contains a substantial amount of sulphur and chlorine and will pass the copper corrosion strip test, and between 1 and 3% by weight of chlorinated aliphatic hydrocarbon boiling above 180C and containing in excess of 85% by weight of chlorine, the combined amounts of the sulfo-chlorinated and phosphorized fatty body and chlorinated aliphatic hydrocarbon in the oil being between 11 and 18% by weight of the lubricant.

**Cutting Oil—Patent #2,394,735**—John S. Yule, assignor to The Pure Oil Company. The method of preparing cutting oil stock which comprises cooking a mixture of a small amount of fatty oil and sulphur chloride with a mineral lubricating oil, heating the mixture to a temperature slightly above the melting point of sulphur, adding sufficient sulphur to give a product having a sulphur content of approximately 3% and cooking the mixture at a temperature of approximately 300 to 350F until no sulfur crystallizes out when the mixture is diluted with an equal part of naphtha and suddenly chilled to 0F or lower.

**Castor Oil Products and Preparation of Same.—Patent #2,394,742**—Franklin A. Bent and Clyde R. Rayn, assignors to Shell Development Company. A process for the production of a product suitable as a varnish oil which comprises heating a mixture consisting of castor oil and a neutral ester of a mono-olefinic monohydric alcohol and a polybasic acid, said alcohol having an olefinic bond between two carbon atoms, one of which is linked directly to a saturated carbon atom having the hydroxyl group linked directly thereto, and said heating being affected in the presence of a dehydration catalyst and at a temperature whereby dehydration of the castor oil occurs.

**Greases—Patent #2,394,790**—Hubert J. Liehe, assignor to Standard Oil Company. A low soap-content grease of the type suitable for ball bearing grease comprising from about 2% to about 25% of a soap selected from the class consisting of an alkali metal soap of a saturated fatty material and an alkali metal-alkaline earth mixed soap of a saturated fatty material, a major portion of which is the alkali metal soap, a small amount, not greater than about 5%, sufficient to produce a smooth consistency-stable grease, of an oil soluble soap of a sulphonic acid of the type derived from petroleum oils, and mineral oil.

**Lubricants—Patent #2,397,907**—Wilfred Gallay and Ira E. Puddington, assignors, by mesne assignments, to Standard Oil Development Company. The process of making greases which comprises dissolving a saponifiable compound in a portion of mineral oil, dispersing a saponifying agent in a non-reactive liquid vehicle, mechanically comminuting said saponifying agent while dispersed in said vehicle until the particle size of said saponifying agent is predominantly at least as low as 5 mn and mixing said solution of saponifiable compound and said saponifying agent dispersion to produce a saponification reaction.

The abstracts in this issue are from the Official Gazette—Vol. 583, Nos. 1, 2, 3, 4; Vol. 584, Nos. 1, 2, 3, 4; Vol. 585, Nos. 1, 2, 3. They cover the issues from Feb. 5. 1946, through April 16, 1946, inclusive.

Printed copies of patents are available from the Patent Office at 10c each. Address the Commissioner of Patents, Washington, D. C., for copies and for general information concerning patents.

**Lubricating Oil Composition—Patent #2,394,909**—Anthony H. Gleason, assignor to Standard Oil Development Co. A lubricating composition comprising a mineral lubricating oil and a viscosity-index increasing amount of an oil-soluble linear polyester reaction product of equimolecular proportions of tri-isobutylene succinic acid and decamethylene glycol, said polyester having a molecular weight in the range of about 5000 to 25,000.

**Lubricant—Patent # 2,394,954**—Walter T. Watkins, Jr., assignor to Standard Oil Development Co. An improved lubricant comprising a lubricating oil and a salt of an alkyl xanthic acid, the alkyl radical of which contains less than 20 carbon atoms.

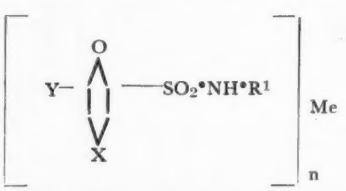
**Refining Lubricating Oil Stocks—Patent #2,394,965**—Ernest F. Engelke, assignor to Cities Service Oil Company. A process for manufacturing lubricating oils which are resistant to oxidation and sludge-formation, comprising contacting a sludge-forming lubricating oil with from 0.5 to 4% of a hydrated inorganic ferric salt at a temperature of from about 340F to 400F, said salt being substantially free of water except for water of crystallization, continuing the contacting for a substantial period of time after which the sludge resulting from the treatment is separated from the oil, neutralizing the treated oil and finally contacting it with a decolorizing clay to produce an oil of desired color which is resistant to oxidation and sludge-formation.

**Electric Solvent-Refining of Petroleum—Patent #2,395,011**—Roderick B. Perkins, Jr., assignor to Petrolite Corp., Ltd. An electrical solvent-refining process for the refining of petroleum oils to remove undesirable organic constituents therefrom which are soluble in a selective solvent partially miscible with the oil and which selective solvent when vigorously agitated with the oil tends to form a mixture of conjugate liquid phases which gravitationally separates slowly and difficultly, which process includes the steps of: forming such a mixture of conjugate liquid phases which will separate gravitationally slowly and difficultly by steps comprising bringing together and vigorously agitating said oil and said selective solvent, said selective solvent having a dielectric constant more than twice that of the oil, said mixture comprising droplets of one phase dispersed in the other; establishing a coalescing electric field of sufficient intensity to coalesce the droplets of said one phase dispersed in the other; subjecting a stream of said mixture of conjugate phases to the action of said electric field to coalese said dispersed droplets; and separating the coalesced droplets from the conjugate phase.

**Cracking and Coking Hydrocarbons Oils—Patent #2,395,081**—Tom Williamson and Ned A. Scardino, assignors, by mesne assignments to The Texas Company. In the conversion of higher boiling hydrocarbon oils into lower boiling ones, the process that comprises passing cycle condensate through a heating zone wherein it is heated to a cracking temperature, combining the resultant heated products with oil for cracking in a reaction zone wherein separation of vapors from liquid residue takes place, maintaining cracking temperatures of the order of upwards of 900F under super-atmospheric pressure in the reaction zone, preventing accumulation of liquid residue therein, withdrawing the liquid residue from the reaction zone together with a portion of the vapors sufficient to support autogenous coking and amount to a proportion of the order of 10-20% of the vapors flowing from the reaction zone, delivering the mixture of liquid residue and vapors to a lower pressure coking zone to thereby effect coking solely by the contained heat of the mixture, separately withdrawing separated vapors from said reaction zone, primarily dephlegmating the evolved vapors from the coking zone to form a tarry condensate, passing the uncondensed vapors to a subsequent dephlegmating zone, introducing the separately withdrawn vapors from said reaction zone directly to said subsequent dephlegmating zone, introducing charging stock into said subsequent dephlegmating zone, withdrawing the resultant mixture of condensate and unvaporized charging stock from said subsequent dephlegmating zone and utilizing the mixture as the oil combined with the heated products from the heating zone for cracking in the reaction chamber as aforesaid, subjecting vapors uncondensed in said subsequent dephlegmating zone to further fractionation to separate a distillate product from a higher boiling reflux condensate and directing said reflux condensate to the aforesaid heating zone.

**Mineral Oil Composition—Patent #2,395,093**—John H. Bishop, assignor to Socony-Vacuum Oil Co., Inc. An improved mineral oil composition comprising a viscous mineral oil fraction having in admixture therewith a minor proportion, sufficient to retard the rust- and emulsion-forming characteristics of said oil fraction, of an oil-soluble alcohol extract of blown lard oil and a minor proportion, sufficient to retard the deleterious effects of oxidation upon said oil fraction, of the condensation product of ethylaniline and formaldehyde.

**Crankcase Lubricant—Patent #2,395,105**—Elmer W. Cook and William D. Thomas Jr., assignors to American Cyanamid Co. A crankcase lubricant comprising a lubricating oil having dissolved therein 0.1-5% of a metal salt of an arylsulfonamide having the formula,




in which x is an alkyl radical, Y is a member of the group consisting of hydrogen and alkyl radicals and x and Y together contain a total of at least 9 carbon atoms, $R^1$ is an aliphatic radical containing at least 8 carbon atoms, Me is an alkaline earth metal and n is the valence of Me.

**Oil Circulatory System Employed in Fuel Injection Pumps—Patent #2,395,330**—Jesse E. Houser, assignor to The Dayton Liquid Meter Co. In combination, an injector pump which includes a plurality of compartments separated by a flexible wall, one of said compartments being adapted to contain fuel and the other of said compartments being adapted to contain pressure fluid, an injection chamber including a fluid circulatory system for causing the pressure fluid to flex said wall and thereby to place the fuel under pressure, means positioned in said circulatory system but positioned remote from said pump for placing the fluid in the system under pressure in order to force disassociated non-condensables in said fluid back into solution during the flexing of said wall.

**Lubricant for Low Temperatures—Patent #2,395,379**—John D. Morgan, assignor to Cities Service Oil Co. The method of lubricating relatively moving metallic bearing surfaces over temperature ranges of approximately 270F extending to temperatures as low as approximately minus 68F, these ranges being such that an ordinary lubricating oil is unable to provide effective lubrication, which comprise maintaining on such bearing surfaces a lubricant consisting essentially of benzaldehyde.

**Low Temperature High Temperature Lubricant—Patent #2,395,380**—John D. Morgan and Russell E. Lowe, assignors to Cities Service Oil Co. A synthetic lubricating oil comprising a homogeneous liquid solution of from 30 to 50 per cent by weight of tri ortho cresyl phosphate, from 20 to 40 per cent by weight of ethylene glycol mono benzyl ether, and from 20 to 40 per cent by weight of tri ortho butyl phosphate.

**Lubricating Composition—Patent #2,395,457**—Gordon D. Byrkit, assignor, by mesne assignments, to The Lubri-Zol Development Corporation. A lubricating composition comprising a major proportion of lubricating oil and a minor amount of a synthetic material obtained by condensing a homogeneous monochloro-wax with anhydrous sodium ortho-chlorobenzoate in the presence of acetic anhydride and pyridine.

**Method for Determining the Oil Content of Subterranean Formations—Patent #2,395,617**—Henri-Georges Doll, assignor to Schlumberger Well Surveying Corp. A method of determining the oil content of an oil-bearing

formation traversed by a bore hole, comprising taking a core of said formation, determining the lithological character of the core and the salinity of the formation water, preparing one or more samples of material having the same lithological character as said formation and containing accurately predetermined proportions of oil and water, said water having the same salinity as said formation water and the number of samples being sufficient to afford an accurate knowledge of the relation between resistivity and oil-content, water content ratio over a continuous range of oil-content, water-content ratio values, determining said relation, measuring in the bore hole the electrical resistivity of the formation, and comparing said measured resistivity with said relation to determine the oil content corresponding to said measured resistivity.

**Preparation of Soluble Oil — Patent** #2,395,627—Herbert L. Johnson and John Herold Perrine, assignors to Sun Oil Co. The process of producing soluble oil from petroleum hydrocarbon starting material having lubricating oil consistency and containing naphthenic constituents in amount providing an average of at least one naphthenic ring per molecule and aromatic constituents in amount sufficient substantially to inhibit oxidation, which comprises subjecting said starting material to liquid phase partial oxidation by means of a free-oxygen containing gas at a temperature within the range of 120-165C and at a superatmospheric pressure not in excess of 175 pounds per square inch, the conditions of temperature and pressure being such as to effect a commercially practical rate of oxidation but said temperature being sufficiently low to prevent the formation of sludge-like products, continuing the oxidation until the oxidized mixture contains a substantial proportion of synthetic acids suitable for soluble oil manufacture while avoiding the formation of more highly oxidized acidic products in appreciably detrimental proportion, treating the oxidized mixture with an aqueous solution of alkali metal hydroxide under such conditions as to effect complete saponification and yield an aqueous mixture comprising alkali metal soaps, unsaponifiable oxidation products and unoxidized hydrocarbons, fractionally acidifying said aqueous mixture with a mineral acid in amount sufficient to convert to free acids a predominant proportion of the soaps of relatively weak acids having utility in manufacture of high quality soluble oil but insufficient to acidify a substantial proportion of the soaps of relatively strong acids having characteristics detrimental to high quality soluble oils, separating resultant aqueous and oily phases, washing the oily phase with water to remove water-soluble contaminants therefrom and thereby yield a refined synthetic acid product the acidic constituents of which include no substantial proportion of relatively strong acids, saponifying said product with an alkali metal hydroxide and blending the saponified product with petroleum oil to yield, as the desired final product, a blend capable of forming stable oil-in-water emulsions.

**Production of Alkaline Earth Metal Sulphonates —Patent** #2,395,713—Carroll B. Barbour, assignor to The Atlantic Refining Company. The method of producing a hydrocarbon oil solution of an alkaline earth metal sulphonate, which comprises sulphonating a viscous hydrocarbon oil, separating spent sulphonating agent and sludge from the sulphonated oil, then neutralizing the sulphonated oil with an alkaline earth metal oxide in the presence of a small quantity of an alkaline earth metal chloride sufficient to maintain the oil in a fluid condition.

**Lubricating Oil—Patent** #2,395,889—Bert H. Lincoln and Gordon D. Byrkit, assignors, by mesne assignments, to Socony-Vacuum Oil Co., Inc. A lubricant comprising in combination a major proportion of oil of lubricating viscosity and a minor proportion of a salt of a sulfurized relatively high molecular weight carboxylic acid, said carboxylic acid sulfurized by reaction with sodium trisulfide.

**Method of Decolorizing Hydrocarbon Oils — Patent** #2,395,931—William A. LaLande, Jr., assignor to Porocel Corp. A method of decolorizing hydrocarbon oil, which comprises contacting said oil with a water-insoluble metal aluminate formed by the reaction in aqueous solution of an alkali metal aluminate and a water soluble salt of a metal capable of forming a water-insoluble metal aluminate, in the presence of a compound yielding $NH_4^+$ ions.

**Thermostatic Oil Cooler Control—Patent** #2,396,053—George W. McEntire, assignor to The Garrett Corp. In an oil cooling device for the circulatory lubricating system of an internal combustion engine, the combination of: a cooler having an oil chamber; inlet means for connecting said chamber so that it will receive hot oil from said engine; outlet means leading from said chamber for return of cooled oil to said engine; a by-passage conduit connecting said inlet means and said outlet means for bypassing said chamber; a valve device for closing said conduit; a thermostat responsive to the temperature of the oil adjacent said chamber and conduit and connected to said valve device for operation thereof, to open and close said conduit under normal pressure conditions in correspondence with temperatures below and above a predetermined value respectively; and a fluid pressure operated device responsive to a pressure differential between said inlet and outlet in excess of a predetermined value for bodily moving said thermostat in a direction and for a distance which serves, when said conduit is closed, to operate said valve device to open said conduit.

**Sealed Bearing Lubricator — Patent** #2,396,124—Joseph S. Pitisci. A sealed bearing lubricator comprising a shell having an inlet for the introduction of lubricant under pressure, a bearing support, means for pressing the bearing against said support, and a valve means opened through engagement with said bearing to pass lubricant from the shell into the bearing.

**Instrument Lubricant—Patent** #2,396,191—John D. Morgan and Russell E. Lowe, assignors to Cities Service Oil Co. An instrument lubricant consisting of the following ingredients by volume, dibutyl phthalate 50%, tributyl phosphate 40%, a polymerized mixture of octyl and decyl esters of methacrylic acid 10%.

**Dental Instrument Lubricant—Patent** #2,396,192—John D. Morgan and Russell E. Lowe, assignors to Cities Service Oil Co. A dental instrument oil consisting essentially of a major portion of a decolorized mineral oil having an average viscosity of about 72 S.U.V. at 100F, and a minor portion of a mixture of equal parts of octyl and decyl esters of methacrylic acid polymerized to a molecular weight of approximately 15,000, the proportions of the oil and methacrylic polymer being such that the final product has a viscosity of about 100 S.U.V. at 100F.

**Lubricating Compositions—Patent** #2,396,223—Carl F. Prutton, assignors to The Lubri-Zol Corporation. An extreme pressure lubricating composition comprising a major proportion of mineral oil, the film strength of which has been substantially increased by the inclusion therein of a minor proportion of a dixylyl disulphide of the type in which at least a portion of the sulphur is on an alkyl group.

**Refining Hydrocarbon Oils — Patent** #2,396,299—Wm. J. Sweeney and Merrell R. Fenske and George H. Cummings, assignors of one-half to Standard Oil Development Co., and one-half to Rohm and Haas Company. A process for separating mineral oil with an average molecular weight less than about 250 into fractions of different chemical and physical properties, which comprises extracting said oil with a solvent consisting of liquid ammonia together with a liquid modifying solvent soluble in said ammonia which reduces the solvent power of ammonia for said oil to form two liquid phases and controlling the amount of oil dissolved in the solvent between the limits of 5 to 30 per cent by weight by addition of said modifying solvent.

**Refining of Mineral Oils — Patent** #2,396,300—George H. Cummings, Wm. J. Sweeney and Merrell R. Fenske, assignors of one-half to Standard Oil Development Co., and one-half to Rohm and Haas Company. A process for the segregation of a diolefin with a molecular weight less than about 250 from a mixture of a diolefin and more saturated hydrocarbons of similar boiling points, which comprises extracting feed mixture with a solvent consisting of liquid ammonia and a minor proportion of a modifying solvent which reduces the dissolving capacity of the ammonia for said feed mixtures and is soluble in liquid ammonia, under conditions to form a raffinate phase and a solvent extract phase containing dissolved therein the diolefin, controlling the concentration of hydrocarbons in the solvent extract phase between the limits of 5 to 30 weight per cent by the amount of said modifying solvent present in the ammonia, separating the solvent extract phase and recovering the dissolved diolefin therefrom.

**Refining of Mineral Oils—Patent** #2,396,301—George H. Cummings, Wm. J. Sweeney and Merrell R. Fenske, assignors of one-half to Standard Oil Development Co., and one-half to Rohm and Haas Company. A process for the segregation of mono-olefin of molecular weight less than about 250 from a mixture of saturated and unsaturated hydrocarbons and a mono-olefin containing constituents of similar boiling points, which comprises extracting in an extraction system a feed mixture with a solvent consisting of liquid ammonia together with a minor proportion of a liquid modifying solvent soluble in liquid ammonia selected from the class of substances which are characterized in that they reduce the dissolving capacity of the ammonia for said feed mixtures, under conditions to form a raffinate phase relatively free of a mono-olefin and a solvent extract phase relatively rich in the mono-olefin, controlling by the amount of said modifying solvent in the ammonia, the concentration of hydrocarbons dissolved in the solvent between the limits of 5 to 30 per cent by weight, separating the phases and removing solvent therefrom.

**Refining of Mineral Oils—Patent** #2,396,302—George H. Cummings, Wm. J. Sweeney and Merrell R. Fenske, assignors of one-half to Standard Oil Development Co., and one-half to Rohm and Haas Company. A process for the segregation of naphthenes with an average molecular weight less than about 250 from a feed mixture consisting of naphthenes and paraffins, the constituents of which boil over a relatively narrow boiling range, which comprises treating said feed mixture with a solvent comprising liquid ammonia under conditions to form a solvent extract phase containing naphthenes and relatively free of paraffins, and a raffinate phase containing paraffins and relatively free of naphthenes, separating the solvent phase containing naphthenes, and recovering solvent and naphthenes therefrom.

**Refining Hydrocarbon Oils — Patent** #2,396,303—George H. Cummings, Wm. J. Sweeney and Merrell R. Fenske, assignors of one-half to Standard Oil Development Co., and one-half to Rohm and Haas Company. A process for the segregation of an aromatic hydrocarbon compound from a hydrocarbon mixture containing constituents with molecular weights less than about 300, which comprises extracting the feed mixture with a solvent consisting of liquid ammonia and a liquid modifying agent selected from the substances which reduce the dissolving capacity of the ammonia solvent for said aromatic hydrocarbon compound and are soluble in liquid ammonia, under conditions to form raffinate and extract phases, controlling the amount of hydrocarbon dissolved in the solvent between the limits of 5 to 30 per cent by weight by addition of said modifying solvent, separating a phase containing aromatic hydrocarbon compound and recovering the solvent and aromatic hydrocarbon compound therefrom.

**Stable Sulphurized Oils and the Method of Preparing the Same—Patent** #2,396,345—Thomas H. Rogers and Joseph S. Wallace, assignors to Standard Oil Co. The method of preparing a stable sulphurized mineral oil comprising sulphurizing the oil with elemental sulphur at a temperature from about 300 F to about 360 F and adding to the sulphurized oil a complex glycerine phosphoric acid ester in a small but sufficient amount to inhibit the formation of sediment in the sulphurized oil.

**Tall Oil Treatment—Patent** #2,396,471—Arthur L. Osterhof, assignor to Hercules Powder Co. In the process of separating the resin and fatty acid components of tall oil, the steps which include heating the tall oil in the presence of a catalyst selected from the group consisting of catalysts having the type formula $RSO_3H$ and $ROSO_3H$, where R is an organic radical, at a temperature between about 150 C and about 325 C, for a time from about 0.25 hour to about 12 hours to decarboxylate the resin acid component, neutralizing the treated tall oil, treating the neutralized mixture with a selective solvent for the decarboxylated resin and separating the solution of decarboxylated resin from the neutralized fatty acids.

**Oil Cooled Pistons—Patent** #2,396,500—Walter Gasser, assignor to Shell Development Company. In a piston assembly, the combination comprising a connecting rod including a coolant conduit extending longitudinally therethrough, a hollow piston ball rigidly mounted on said connecting rod, a distribution nozzle vertically mounted on said connecting rod within said piston ball in flow communication with said coolant conduit and adapted to direct coolant against the top inner surface of said piston ball and a ring belt unit engaging said piston ball to form a ball and socket joint, said piston ball extending above the top of said ring belt unit and forming the piston head.

**Conversion of Hydrocarbon Oils—Patent** #2,396,641—Gerald C. Connolly, assignor to Standard Oil Development Company. A process for cracking higher boiling hydrocarbons to form lower boiling hydrocarbons suitable for motor fuel, which comprises passing the oil to be cracked in vapor state and in the absence of added hydrogen through a cracking zone containing a catalyst consisting of a major portion of alumina and a minor portion of tungsten oxide, and maintaining said oil vapors within said cracking zone at a temperature and for a period sufficient to effect a substantial conversion of said oil into lower boiling hydrocarbons.

**Art of Separating Constituents of Tall Oil—Patent** #2,396,651—Torsten Hasselstrom. The process of separating resin acid and fatty acid fractions from tall oil containing abietic acid, which comprises esterifying the fatty acids with an alcohol in the presence of an acid esterifying catalyst, distilling to remove excess alcohol from the product and then adding a disproportionation catalyst and heating the mixture to a temperature of substantially 185 to 230 C and thereby disproportionating the resin acid molecules to form dehydroabietic and dihydroabietic acids, and then separating the esterified and disproportionated mixture into a fraction rich in stabilized resin acids and a fraction rich in fatty acid esters.

**Process for Modifying Fatty Oils—Patent** #2,396,670—Lazlo Auer. The method of modifying a fatty oil to improve its drying characteristics, which comprises incorporating in the oil up to 30% of fluorescein and heating the mixture to a temperature between about 200 C and about 350 C but not above the boiling point of the oil.

**Petroleum Mahogany Sulphonic Products — Patent** #2,396,673—Manuel Blumer, assignor to L. Sonneborn Sons, Inc. Method for the production of petroleum mahogany sulphonic products, which comprises treating a non-settled acidified petroleum hydrocarbon oil containing petroleum mahogany sulphonic acids, acid sludge and unreacted oil, derived from the sulphuric acid treatment of a straight overhead distillate, having a Saybolt viscosity at 100 F of at least 150 seconds, under sulphonating conditions of acid amount and temperature, with an organic normally liquid solvent selected from the group consisting of normally liquid benzol, bensol homologues, chlorbenzol, chlorinated benzol homologues and saturated chlorinated aliphatic hydrocarbons, permitting the reaction mix to settle to thereby obtain a top layer predominately containing petroleum mahogany sulphonic acids and oil in solution in said solvent, and thereafter recovering from said layer a petroleum sulphonic product of high purity substantially free from discoloring materials.

**Emulsification of Vegetable and Animal Oils—Patent** #2,396,718—Abraham Moscowitz, assignor to L. Sonneborn Sons, Inc. A composition of matter for blending with oils selected from the group consisting of animal and vegetable oils and blends of such oils with mineral oils to form substantially instantaneously emulsifiable products, which comprises 63 to 74% by weight alkali metal petroleum mahogany sulfonate, 9 to 11% by weight alkali metal oleate, 4 to 6% by weight free oleic acid, 12 to 14% by weight of at least one mem-

ber selected from the group consisting of glycols and glycol monoalkyl ethers, and 1 to 6% by weight of water.

**Lubricants—Patent #2,396,719** — John M. Musselman and Herman P. Lankelma, assignors to The Standard Oil Company. A lubricant comprising a lubricating oil, and an addition agent comprising a metal compound of the reaction product of phosphorus pentasulfide and an aliphatic saturated alcohol having at least 8 carbon atoms reacted at a temperature above 100 C to prevent thiophosphate formation.

**Process of Preparing an Aluminum Soap from Spent Aluminum Halide Catalyst and a Grease from Said Soap —Patent #2,396,744**—Arnold J. Morway, assignor to Standard Oil Development Company. The process of manufacturing a lubricating grease which comprises mixing a high molecular weight organic monobasic acid with a Friedel-Crafts type metal halide catalyst spent in a hydrocarbon conversion process and consisting of a hydrocarbon complex of a halide of a metal having a valence of at least 3, heating the mixture to reaction temperatures of between 150 F and 300 F until the reaction is substantially complete as indicated by a cessation of the hydrogen halide liberation and blending the resultant soap into a mineral lubricating oil base stock in amounts sufficient to produce a substantially homogeneous lubricating grease.

**Catalytic Conversion of Hydrocarbon Oils — Patent #2,396,758**—Reginald K. Stratford, assignor to Standard Oil Development Company. A method of producing gasoline by cracking hydrocarbon oil, which comprises admixing the oil to be cracked with an undried hydrous silica prepared from a metal silicate solution and containing imbibed water and having mixed therewith an active oxide cracking catalyst, passing the mixture of hydrocarbon oil and hydrous silica oxide mixture through a cracking zone, maintaining said cracking zone at a temperature of from 1000 to 1200 F and under a pressure of at least 200 lbs/sq.in., controlling the temperature and pressure relationship within said zone to keep said oil in vapor phase therein, withdrawing cracked products from said cracking zone and fractionating said cracked products to segregate a gasoline fraction therefrom.

**Modified Oil—Patent #2,396,763** — Harry M. Ullmann. The process of modifying raw castor oil, which comprises reacting raw castor oil with from 5% to 20% of maleic anhydride at between 95 and 140 C in the substantial absence of other reactants for at least one hour.

**Lubricating Composition—Patent #2,396,839**—Elliot Alfred Evans and John Scotchford Elliott. The method of making a lubricating composition which comprises reacting an aromatic hydroxy-ester containing aromatic radicals coupled through sulphur with an organic di-substituted phosphorus chloride compound to produce an oil-soluble phosphite ester effective to increase the film-rupture strength of a lubricating oil base in which it is dispersed.

**Refining of Mineral Oils — Patent #2,397,077**—James C. Alspaugh, assignor to Standard Oil Development Company. Process for the removal of sulfur compounds from oils containing the same, which comprises contacting a feed oil in an initial stage, utilizing a mineral acid, separating the acid sludge from the oil, treating the oil with a dilute aqueous solution of calcium chloride, separating the calcium chloride solution and neutralizing the oil with an alkali metal hydroxide solution.

**Transformer Oils—Patent #2,397,332**—Earl Arnott, assignor to Union Oil Company of California. A transformer oil consisting essentially of a light mineral oil of the transformer oil type and a small proportion, less than about 0.5%, sufficient to inhibit oxidation of said transformer oil, of di-cyclo hexyl tartrate.

**Mineral Oil Compositions and Methods of Suppressing Foaming of Oils — Patent #2,397,377**—Herschel G. Smith and Troy L. Cantrell, assignors to Gulf Oil Corp. A mineral oil composition resistant to foaming, comprising mineral oil and a small proportion of dimethylaniline isoamyl octyl orthophosphate exhibiting a pH value between approximately 2 and 4.

**Mineral Oil Compositions and Methods of Suppressing Foaming in Oils—Patent #2,397,378**—Herschel G. Smith and Troy L. Cantrell, assignors to Gulf Oil Corp. A mineral oil composition resistant to foaming, comprising mineral oil and 0.01 to 1.0 per cent of quinoline isoamyl octyl phosphate by weight of the oil.

**Mineral Oil Composition Resistant to Foaming—Patent #2,397,379**—Herschel G. Smith and Troy L. Cantrell, assignors to Gulf Oil Corp. A mineral oil composition resistant to foaming, comprising mineral oil and a small proportion of pyridine isoamyl octyl phosphate.

**Mineral Oil Composition Resistant to Foaming—Patent #2,379,380**—Herschel G. Smith and Troy L. Cantrell, assignors to Gulf Oil Corp. A mineral oil composition resistant to foaming, comprising mineral oil and a small proportion of a lutidine isoamyl octyl phosphate.

**Mineral Oil Compositions and Methods of Suppressing Foaming in Oils—Patent #2,397,381**—Herschel G. Smith and Troy L. Cantrell, assignors to Gulf Oil Corp. A mineral oil composition resistant to foaming, comprising mineral oil and a small proportion of nicotine isoamyl octyl phosphate, the proportion of nicotine isoamyl octyl phosphate being sufficient to overcome the normal foaming tendency of the mineral oil and to suppress the foaming of the oil composition when agitated under service conditions.

**Method of Preparing Lubricating Oils — Patent #2,397,662** — Lawrence M. Henderson and Weldon Grant Annable, assignors to The Pure Oil Co. The method of preparing lubricating oil which comprises distilling cylinder stock from Pennsylvania oil under light cracking conditions at a temperature of approximately 700 F at pressures not substantially above atmospheric pressures in the presence of a light hydrocarbon diluent, injecting steam into the body of cylinder stock undergoing distillation at such rate that the volume of steam is approximately equal to the volume of hydrocarbon vapors produced, condensing the vapors, continuing the distillation until approximately 91.2% by volume of the cylinder stock is distilled, adding to the distillate approximately 15% of petrolatum, removing from the mixture fractions boiling within and below the gas oil range, diluting the remainder with naphtha, chilling the solution to a temperature of approximately —35 F, centrifuging it to remove wax and removing the naphtha from the dewaxed oil.

**Agent for Mineral Oils and Mineral Oil Composition Containing the Same — Patent #2,397,702**—Herschel G. Smith and Troy L. Cantrell, assignors to Gulf Oil Corp. A suitable additive for mineral oils whih comprises a metal salt of a sulfurized derivative of a ricinoleic acid reaction product of a diaryl-chloro-phosphite which has been made by esterifying an alkylated phenol which contains at least one alkyl group having from 3 to 5 carbon atoms with phosphorus trichloride.

**Diesel Fuel Oil—Patent #2,397,771**—Benjamin T. Anderson and Marcellus T. Flaxman, assignors to Union Oil Co. of California. A Diesel fuel containing in the order of 0.01% to 0.5% of a high molecular weight organic acidic material obtained from petroleum fractions by caustic treatment thereof and recovered as a heavy normally solid to semi-solid bottoms fraction by distilling over the normally liquid naphthenic acid components.

**Base Coat for Launching Grease—Patent #2,397,805**—Thomas F. Ott, assignor to Union Oil Co. of California. A base coat composition for launching greases comprising a composition of paraffin wax having a solidification point between about 140 F and about 165 F and containing amorphous wax, the wax being the major proportion of the composition, and asphalt having a melting point of at least 110 F, but not above 155 F, the product having a Galician solidification point of above about 135 F.

A base coat composition for launching greases, comprising crystalline paraffin wax and amorphous paraffin wax, the combined wax content constituting a major proportion of the composition, and having a solidification point above about 140 F and resin between about 5% and about 15% of the composition, the composition having a solidification point above 135 F.

**Refining Fatty Oils—Patent #2,397,874**—Katherine Lloyd and Havard L. Keil, assignors to Armour and Company. A process for refining fatty oil containing oil-soluble proteins to obtain a refined oil substantially free of said proteins, comprising subjecting said oil to the action of a hydrolyzing proteolytic enzyme in the presence of water to produce from said proteins and water a gelatinous water-insoluble flocculation which is insoluble in said oil, and separating said oil-insoluble water-insoluble flocculation from the oil.

**Gun Oil Composition—Patent #2,397,904**—James E. Shields, assignor to Alox Corp. A corrosion inhibiting lubricant composition for small arms and the like comprising a substantially neutral solution, in a highly refined petroleum lubricating oil of low pour point, of substantially neutral components of about 5 parts by weight of wool grease, about 0.4 part by weight of lecithin and about 4.35 parts by weight of methyl esters of high molecular weight saturated aliphatic acids derived from the oxidation of lubricating oil, at superatmospheric pressure and elevated temperature in the presence of a promoter of oxidation, together with oil-soluble calcium soaps of acids normally present in such wool grease, lecithin and methyl esters and about 0.25 part by weight of calcium amyl phenate oxidation-retarding agent, the content of lubricating oil in said composition being sufficient to bring the total to 100 parts by weight.

**Stabilization of Oils and Fats—Patent #2,397,920**—Mayne R. Coe, Jr. and Mayne R. Coe, assignors to the United States of America as represented by the Secretary of Agriculture. A process for retarding development of rancidity in non-stable vegetable glyceride oils and animal glyceride fats, comprising adding to and mixing with them tocopherol plus an enzyme, selected from the class consisting of trypsin, pepsin, and clarase.

**Production of Lubricants—Patent #2,397,956**—Harold M. Fraser, assignor to International Lubricant Corp. A lubricating grease containing a grease-forming lubricant base and a lithium soap of 12-hydroxy stearic acid in a quantity which increases the ability of the grease to maintain its consistency when mechanically worked.

**Method of Refining Waxes—Patent #2,397,969**—Robert A. Macke and Herman J. Zoeller, assignors to Standard Oil Development Co. Process for the production of paraffin waxes of improved heat and light stability which comprises segregating from wax-containing petroleum oils a wax fraction containing not more than about 50% of oil, distilling the same over excess sodium hydroxide solution, and recovering an overhead of improved heat and light stability.

**Stabilization of Fats and Oils—Patent #2,397,976**—Daniel Keith O'Leary, assignor to E. I. du Pont de Nemours and Co. A process which comprises protecting against rancidity a member of the group consisting of edible vegetable, animal, and fish oils, fats, and waxes, by incorporating therein a compound selected from the group consisting of thio di-fatty acids and their esters.

**Oil Rings—Patent #2,398,030**—Allen W. Morton, assignor to Koppers Company, Inc. A piston ring assembly for mounting in a ring groove, comprising in combination an expansible spacer ring having oil ports; a pair of expansible scraper rings, one on each side of the spacer ring, said scraper rings being relatively thin and having each a flange that overhangs the edge of the inner periphery of the spacer ring; and an expander arranged to react against the flange of the scraper rings.

**Grease Manufacture—Patent #2,398,075**—Lawrence C. Brunstrum and Hubert J. Liehe, assignors to Standard Oil Co. In the manufacture of a lime grease, the improvement which comprises hydrating a lime soap in the presence of a preferentially water soluble surface active substance capable, in a small proportion less than about 2.5% by weight based on the lime grease, of appreciably reducing the interfacial tension between water and a hydrophobic phase.

**Rust Inhibitor for Turbine Oil—Patent #2,398,120**—Hans Schindler, assignor to The Pure Oil Co. The method of preparing a rust inhibitor for steam turbine oils which comprises neutralizing used aqueous alkali solution from the treatment of petroleum distillates containing phenolic bodies to a pH of approximately 8 and contacting with a solid adsorbent material the resulting "acid oil" mixed with a low-boiling solvent for said "acid oil," but which solvent is incapable of extracting from said adsorbent material deleterious ingredients adsorbed from said "acid oil," the amount of said adsorbent and time of contact being sufficient to remove from the "acid oil" ingredients which deleteriously affect the rust inhibiting properties of said "acid oil."

**Lithium Soap Greases—Patent #2,398,173**—Lawrence C. Brunstrum and Hubert J. Liehe, assignors to Standard Oil Co. A lithium soap grease comprising at least 5% of a lithium soap, a major proportion of a hydrocarbon oil and between about 0.2% and about 2% of an unsulfurized ester of a polyhydric alcohol and an acid.

**Lubricant—Patent #2,398,193**—Thomas E. Sharp, assignor to Standard Oil Co. A rust preventive lubricant comprising a major proportion of a lubricating oil an ester of and minor corrosion inhibiting proportions of an anhydroalkitol and a carboxylic acid and an aliphatic soap of a preferentially oil-soluble petroleum sulfonic acid.

**Composition of Matter—Patent #2,398,271**—John C. Zimmer and Arnold J. Morway assignors to Standard Oil Development Co. The method of making a sulfurized lubricating oil additive which consists in heating a polymer having a viscosity of 500 to 10,000 at 100 F obtained by the vapor phase clay treatment of steam cracked petroleum distillates with a sulfurizing agent at a temperature between 300-400 F for from 30 minutes to 3 hours.

**Process for Producing a Tall Oil of Low Viscosity and Free From Crystallization—Patent #2,398,312**—William H. Jenning, assignor to Camp Manufacturing Co., Inc. Process of producing a tall oil of stabilized low viscosity and freedom from crystallization by the selective polymerization of a band of the resin acids content which are polymerized by reaction with sulphuric acid having a concentration within a range of from 85% to 87%, comprising, first controlling the acid concentration in the reaction zone by reducing the moisture content of the tall oil to a minimum not substantially exceeding one-tenth of one percent the weight of the tall oil, then reacting the tall oil with a quantity of sulphuric acid having a concentration of from 85% to 87% equal to approximately 20% of the resin acids content of the tall oil, until selective polymerization is completed, the temperaure of the tall oil during the reaction step being held within a range which does not materially exceed 40 C.

**Mineral Oil Composition and The Like—Patent #2,398,415**—George H. Denison, Jr., and Paul C. Condit, assignors, by mesne assignments, to California Research Corp. A composition of matter, comprising an oil and a small amount, sufficient to stabilize the oil, of a compound of the type

$$R—(X)_n—R_1$$

where R and $R_1$ are like or unlike alphatic radicals at least one of which contains not less than 8 carbon atoms, X is an element selected from the group consisting of selenium and tellurium and n has the value of 1 or 2.

(Continued on page 75)

# FIRST A. S. L. E. NATIONAL MEETING

**Speakers, seated: C. E. Trautman, M. E. Merchant, G. H. Von Fuchs, N. C. Penfold, H. Vagtborg. Standing: S. Kyropoulos, H. E. Mahncke, A. Bondi and A. J. Jennings.**

## A.S.L.E. Holds First Convention!!

WITH the War successfully over, nothing stood in the way of holding the Convention this year. Last year, travel restrictions made it necessary to call off the Convention almost at the last minute.

With the Chicago Section acting as host, more than 300 formal registrations were recorded at the two-day meeting held at the Stevens Hotel.

On the first day, April 5th, with C. E. Pritchard, President of the Society, presiding, papers were presented by Dr. H. E. Mahncke of the Westinghouse Research Laboratories, East Pittsburgh, Pa., on "What is a Lubricant?"; by Mr. A. J. Jennings of the Farval Corporation, Cleveland, Ohio, on "Centralized Lubrication;" by Mr. A. F. Underwood of the General Motors Corporation, Detroit, Michigan, on "Automotive Engine Lubrication."

At the luncheon meeting, which was well attended, N. C. Penfold introduced Mr. H. Vagtborg of the Midwest Research Institute, Kansas City, Missouri, who gave an interesting paper on "Industrial Research Trends."

The afternoon session was presided over by Dean J. C. Peebles, who introduced Dr. S. Kyropoulos of the California Institute of Technology, Pasadena, California, who spoke on "The Metallurgical Background of Bearing Failure and Boundary Lubrication;" Mr. A. Bondi of International Lubricant Corporation, New Orleans, Louisiana, whose paper was entitled "The Relationships Between Flow Characteristics and Chemical Structure of Lubricants;" Dr. M. E. Merchant of Cincinnati Milling Machine Company, Cincinnati, Ohio, who presented a paper on "Characteristics of Typical Polar and Non-Polar Boundary Films Under Stick-Slip Conditions;" with the final paper of the day by Mr. A. E. Meyer of Meyer Sheet Metal Machinery Company, Los Angeles, California, entitled "Lubricating Pressed Metal Production Machinery."

The Banquet was held the evening of April 5th, at which the ever genial Mr. E. J. Ehret of the Farval Corporation office in Chicago was Master of Ceremonies. The new officers were introduced at that time, and finally the speaker of the evening, Dr. Otto Eisenschiml. Dr. Eisenschiml gave a most interesting discussion of scientific research applied in crime analysis.

The Saturday morning session was presided over by Dr. E. M. Kipp of the Aluminum Company of America, New Kensington, Pennsylvania, the new President of the Society. At this meeting, Mr. V. A. Ryan of The Crown Cork and Seal Company, Baltimore, Maryland, spoke on "Measurement of Lubricant Film Strength in the Region of Boundary Friction"; Mr. C. E. Trautman, of the Gulf Research and Development Company, Pittsburgh, Pennsylvania, spoke on "Foaming of Lubricating Oils"; Dr. G. H. Von Fuchs of the Shell Oil Company, Wood River, Illinois, presented a paper on "Protective Value of Industrial Lubricants"; Mr. P. W. Wendt of Grafo Colloids Corporation, Chicago, Illinois, presented a discussion on "Surface Conditioning of Metals in Friction"; with the last paper of the session being given by Mr. C. A. Winslow of Winslow Engineering Company, Oakland, California, on "The Development of Lubricating Systems as Applied to Engines."

All of the papers were well received and followed by active discussion. Plans are being made to print them in the coming issues of LUBRICATION ENGINEERING.

At the Directors' meeting held the afternoon of April 6th, formal approval was given to the two new Directors who were nominated by the Sustaining Membership group to represent the company views on the Board. Mr. C. E. Pritchard was elected Director representing the Consumer group of Sustaining Membership companies, and Dr. E. S. Ross to represent the Supplier

(*Continued on page* 79)

**Speakers' Table at A.S.L.E. banquet. Seated: C. A. Bierlein, Dir.; B. H. Jennings, Sect'y-Treas.; Dr. O. Eisenschiml, banquet speaker; E. J. Ehret, Master of Ceremonies; E. M. Kipp, Pres.; E. F. Graves, Dir.; G. L. Sumner, Dir. Standing: W. F. Leonard, V. Pres.; W. T. Everitt, Dir.; D. E. Whitehead, Ch. By-Laws Comm.; N. C. Penfold, Retiring Dir.; G. E. Radosevich, Dir.; C. E. Pritchard, Dir. & Past Pres.; D. N. Evans, Ch. Finance Comm., and A. Chadburn, Adv. Mgr. LUBRICATION ENGINEERING.**

# New Member Applications*

**The following applications for membership have been received since February 20, 1946. Most of these have been already acted upon by the Admissions Committee and, at the present time, are members of the Society. This list, as a supplement to the complete membership list published in the December, 1945 issue of "Lubrication Engineering," and the supplementary membership list published in the March, 1946 issue, represents the Society's membership as of May 1, 1946.**

ASHWORTH, D. IRVING
*The DeLaval Separator Co.*
The DeLaval Separator Co.
Foot of Pine St.
Poughkeepsie, New York

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Ekco Products Co.
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BECHTEL, DAVID S.
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Balcrank Sales and Service Co.
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New Kensington, Pa.

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Portland 1, Oregon

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Baltimore, Maryland

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Hoover Ball & Bearing Co.
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Nordberg Mfg. Co.
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*Jos. H. Yerkes & Co.*
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Shell Oil Co., Inc.
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Henan-Crane Corp.
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Carbide and Carbon Chemicals Co.
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KRAUSE, WALLACE H.
*Allis Chalmers Mfg. Co.*
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WILLIAMS, DEWEY L.
*Cities Service Oil Co.*
R. D. No. 1—Verona Road
Verona, Pennsylvania

**Members are urgently requested to advise the Secretary of changes in address or changes in occupation. Please notify:**

**BURGESS H. JENNINGS,**
**Northwestern Technological Institute,**
**Evanston, Illinois.**


*Sulphur and Chemical Additives*

MODERN DEVELOPMENTS FOR THE

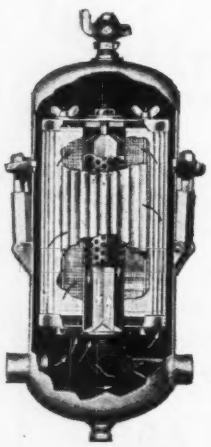
☆ OIL AND METAL INDUSTRIES

BURNS LABORATORIES, Inc.
514-520 WEST WYOMING STREET
INDIANAPOLIS 2, INDIANA

Copy of this booklet available upon request.

## New Liquid Filter Provides Quick Change of Medium

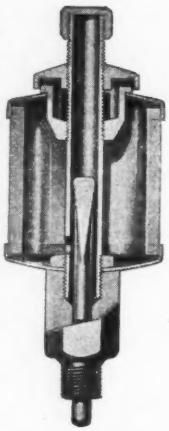
The recently announced *Staynew Model ELS Filter* features an entirely new and far superior design of filter insert. Insert assembly consists of inner and outer radial finned forms of wire cloth. The outer form, on which the filtering medium is crimped, slips over the inner form. Top and bottom plates and seal gaskets are then applied and the whole assembly held in place by through bolts.



The new type insert, known as the *Slip-On,* is said to permit the use of practically any type of filtering medium obtainable in sheet form that can be crimped. It also permits quick change or replacement of filtering medium in the field. Spare insert outer forms are relatively inexpensive and may be stocked in a variety of media ready for instant change or replacement, according to the manufacturer.

Further information is available from J. S. Zahniser, Sales Manager, Dollinger Corp., Rochester 3, N. Y.

## Bottle Oiler



The Oil-Rite Corporation, 3428 South 13th Street, Milwaukee 7, Wisconsin, announces a new *Vibrating Rod Bottle Oiler,* especially suited for the application of light or medium bodied oils to sleeve and shaft bearings, spindle bearings and similar applications. The oiler embodies all brass construction with unbreakable Lucite reservoir and an airtight filler cap which cannot come off or be lost. Sizes available range from ½ oz. to 32 oz. oil capacity, and the unit is made in pipe thread sizes from ⅛ to ½ in. inclusive.

In describing its operation, the manufacturer points out that the oil is fed from the airtight reservoir to a feed rod which rides lightly on the journal. The rotational drag of the shaft imparts a slight vibration to the feed rod, and this results in a pumping action as long as the shaft is turning. The feed can be regulated to some extent.

It is claimed that, unlike most bottle type oilers, this one can be refilled without removing it from the installation, and this, along with other features, makes the device especially well suited for dusty surroundings.

Further details are available from the manufacturer.

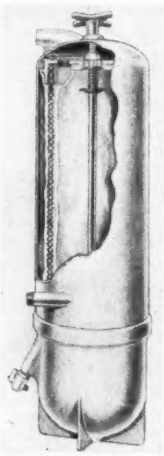
## New Filtering Materials for Purifying Heavy Duty Detergent Type Oils

The Hilliard Corporation has available new filtering materials for use in HILCO Oil Reclaimers and HILCO Hyflow Oil Filters for purifying additive, detergent, or inhibited lubricating oils.

Adstay (cellulose) Filter Discs are now available for use in the HILCO Oil Reclaimers. This material can be used in these units now in the field without making any mechanical changes in the equipment, and the material is simply substituted for Hilite—fuller's earth formerly used. The manufacturer claims that the material has been tested by some of the major oil companies and laboratories, and found to be excellent for filtering oils clean without removing the additive compound.

Hiltex—cellulose is the material used in filter elements made by the manufacturer for the Navy for filtering heavy duty oils and is now available to commercial users having HILCO Hyflow Oil Filters in service. The manufacturer is in a position to recommend the proper type of filtering materials for the handling of all kinds of lubricating and industrial oils, and those interested in this field should communicate with the manufacturer, The Hilliard Corporation, 102 West Fourth Street, Elmira, New York.

## Grinder Coolant Filter



A new filter for cleaning grinder coolant and similar solid-bearing fluids is introduced by Cuno Engineering Corporation of Meriden, Conn., in an announcement which promises savings in filter cost, maintenance and replacement.

The *Coolant-Klean* has a replaceable bag-type filter element mounted on a screen spacer so as to provide a filtering area of 1000 sq. in. for full flow. It is claimed that less space is required than for other, more expensive types, no filter aid is needed, and precoating time is eliminated.

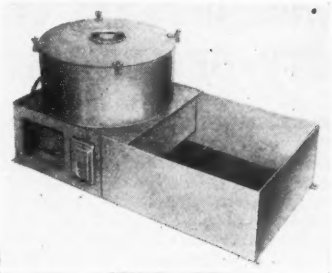
When replacement of the bag is necessary, this is accomplished in less than five minutes. Loosening a single screw clamp opens the filter; the dirty element is discarded and the accumulated grit emptied from the sump. A clean bag is installed easily.

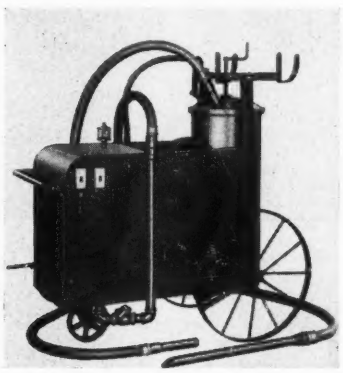
The *Coolant-Klean* can be applied to any type of grinder and is also adaptable to almost any machine using a coolant or cutting oil. No alteration of the grinder is necessary. Installation of the complete unit between the grinder pump and the work nozzle averages about 15 minutes. Only two flexible hose connections are necessary. No extra pump, electrical work, plumbing, valves or by-passes are required.

## Emulsions and Filters

Three new products, one an emulsion breaker for lubricating oils and the other two mechanical filters for oils and coolants used in machine tool operations, have been announced by the Honan-Crane Corporation, Lebanon, Ind., manufacturers of oil purification equipment.

The de-emulsifier, called "Visco 77," when added to lubricating oil and water in the amount of 0.1 per cent, is said to cause all water to settle out in 24 to 48 hours if emulsion is maintained at rest at a temperature of 180 to 185 F. The makers claim that "Visco 77" is harmless to lubricating oil and has been used with safety in circulating systems employing thousands of gallons of lubricating oils where water contamination of from 5 to 15 per cent was encountered, together with appreciable quantities of dust, dirt, iron oxide and scale, etc.





The coolant filters are a mobile, low-operating cost filter, mounted on a cart, and a central power device for permanent installation. The portable outfit removes the coolant, extracts all chips, abrasives and dirt, and then replaces the oil or coolant after which it can be trundled to another machine tool for similar operation, the manufacturer states. Easy cleaning of the filter and more effective results than messy hand cleaning methods are stressed by the makers. Similar advantages are cited for the power unit which is recommended wherever a continuous supply of abrasive-free coolant is necessary.

## Capt. M. B. Lawton of Lincoln Engineering Co. Decorated

Capt. Morgan B. Lawton was recently presented with the Legion of Merit Medal by Major Gen. Henry B. Sayler, Deputy Chief of Ordnance, at ceremonies held in Washington. The award was given Capt. Lawton for his success in initiating and establishing a program of standardization and improvement of lubrication equipment which he headed during the war. This program was eminently successful in providing better and more easily maintained equipment and greatly simplified the application of lubricants to Ordnance material.

Mr. Lawton became associated with the Lincoln Engineering Company of St. Louis in 1937. He joined the Army Ordnance Department in 1942 and is again back with Lincoln.

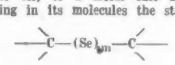
## Oil Treating Processes and Equipment

The Buckeye Laboratories Corporation, 7016 Euclid Avenue, Cleveland 3, Ohio, has recently published a bulletin on the application of the *Buckeye Process* for the complete cleaning, dehydrating, degasifying and stabilizing of oils. The bulletin describes the equipment and process in detail, and illustrates specific applications such as the treatment of electric insulating oils, turbine bearing oils, cable-filling oils, vacuum-sealing oils and others. Each description is accompanied by a flow chart for the particular process.

## Abstracts

(*Continued from page* 70)

**Compounded Oil—Patent #2,398,416**—George H. Denison, Jr., and Paul C. Condit, assignors, by mesne assignments, to California Research Corp. A composition of matter comprising a major proportion of an oil of lubricating viscosity and a small amount each, sufficient to improve the oil, of a metal salt detergent and a compound having in its molecules the structure



wherein the carbon atoms are aliphatic carbon atoms and m is 1 or 2.

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# NATIONAL OFFICERS OF THE AMERICAN SOCIETY OF LUBRICATION ENGINEERS

President
EGBERT M. KIPP

Dr. E. M. Kipp was born of missionary parents in Angola, Portuguese West Africa on November 27, 1914. He received his elementary school education from his Father and did preliminary college work at a Portuguese Military High School. He has traveled extensively in Africa, Europe, South America and the United States.

He received a B. S. degree from Iowa Wesleyan College, A.M. degree from Boston University and a Ph.D. degree from Pennsylvania State College. Since 1939, he has been employed by the Aluminum Research Laboratories of the Aluminum Company of America, New Kensington, Pa., of which he is now Assistant Chief of the Physical Chemistry Division, In Charge of the Oils and Lubricants Section. A major share of his duties has been associated with specialized problems of metal process lubrication, power steam oils, Diesel engine lubrication, etc.

He is a member of the American Chemical Society; Pittsburgh Chemist's Club; Sigma Xi; Phi Mu Epsilon, a national honorary mathematics society; Iota Phi, honorary scholastic society; and of the Sigma Phi Upsilon fraternity.

Eastern Vice-President
D. F. HOLLINGSWORTH

Mr. D. F. Hollingsworth was born near Russiaville, Indiana, in 1910. He was graduated from Purdue University with the degrees of B.S. in Mechanical Engineering in 1932 and M.S. in Engineering in 1936, during which period he specialized in Refrigeration and Air Conditioning work. As an undergraduate, he was prominent in athletics, gaining western conference and national honors as a pole-vaulter on the Purdue track and field team.

During the period between his undergraduate and graduate work, Mr. Hollingsworth served as Chief Engineer for Earlham College at Richmond, Indiana. He had charge of the operation of power, electrical generating and heating facilities and the maintenance of all mechanical and electrical equipment.

After completion of his graduate work, he was employed by the Engineering Department of E. I. du Pont de Nemours and Company. Several years were spent in the Industrial Engineering Division as a Field Engineer in plants at Deepwater, N. J., Waynesboro, Va. and Grasseli, N. J. In 1939 he was transferred to the Wilmington office as a Lubrication Consultant. Since February 1943, he has directed the lubrication engineering activities for the du Pont Company and acts as the Lubrication Consultant for 83 plant locations in 25 states.

Mr. Hollingsworth has been a member of A.S.L.E. since its inception and has served as Chairman of the Nominating Committee and a member of the Program, Planning and Publications Committee. He served also as temporary Chairman of the Philadelphia Section during its organization.

Mr. B. H. Jennings, Secretary-Treasurer of the American Society of Lubrication Engineers, was born in Baltimore, Maryland in 1903, and obtained his early engineering education at the Johns Hopkins University. He did his graduate work at Lehigh University, receiving the M.S. degree in 1928.

He was a member of the teaching staff at Lehigh University from 1926 to 1940, leaving Lehigh University to become Professor of Mechanical Engineering and Chairman of the Department at the Technological Institute of Northwestern University in 1940.

In addition to his work in education, Professor Jennings has been an active engineering consultant and has directed a large amount of research work. In particular, during the war, Mr. Jennings has been active in the conduct of a confidential research project for the Office of Scientific Research and Development.

More than a score of technical papers are credited to his name, and he is the author or co-author of four books.

Active in Society work, he is a member of the A.S.M.E., A.S.H.V.E. and A.S.R.E.

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Midwestern Vice-President

## W. F. LEONARD

Mr. W. F. Leonard hails from New England, his birthplace being Baldwinsville, Massachusetts. He attended school there, completing his education in Boston.

For many years he was in the manufacturing business, being mainly connected with paper. He left this field long enough to spend several years in Europe as a manufacturer's representative for heavy machinery. Following this, he returned to America and for several years was in manufacturing business for himself. Throughout his life he has been much interested in the field of labor relations.

It was largely through his interest in machinery that he developed an extensive background in the field of lubrication. Early in the War Mr. Leonard was invited to the Studebaker Airplane Engine Factory to take charge and plan the complete lubrication program for that large plant.

When the war ended Mr. Leonard resumed his occupation as a consulting engineer in lubrication practice. He resides in Chicago.

Western Vice-President

## R. G. LARSEN

Dr. Robert G. Larsen was born in Utah in 1909. He graduated in Chemistry from the University of Utah in 1931 and received the Master's degree from that institution in 1932. Following this he continued graduate study at Harvard, receiving his Ph.D. in Chemistry in 1935. During part of this time he was employed at the Everett plant of the New England Coke Company. The following two years were spent as a member of the staff of the Department of Electrical Engineering at the Massachusetts Institute of Technology where he was engaged in research on liquid dielectrics. He joined the staff of the Shell Development Company, Emeryville, California, in 1937 and became head of the Lubricating Oil Department in 1940. He has been an author of several articles dealing with oil oxidation, catalysis, lubrication, bearing corrosion, detergency and other properties of oils.

Director

## C. E. PRITCHARD

Mr. C. E. Pritchard graduated in Mechanical Engineering at the Carnegie Institute of Technology in 1932. Upon his graduation he joined the Lubrication Department of the Atlantic Refining Company and left in August, 1937, to become millwright at the Warren District of the Republic Steel Corporation (Strip Mill Department). Here he rebuilt and managed the installation and maintenance of mill machinery. In July, 1938, he assumed the duties of Lubrication Engineer for the Warren District, which comprised the Warren Plant, Niles Plant, Trumbull-Cliff Furnaces and Newton Falls Plant.

He became Chief Lubrication Engineer of all Republic Steel Corporation operations, including all steel plants, manufacturing divisions and mines in March, 1941.

Mr. Pritchard has been active in society and committee work, including membership on the Slushing Oil Committee of the A.I.S.E., from 1941 to the present date, the Program Committee (lubrication sections) and on the Membership Committee of the A.I.S.E.

Director

## EDGAR S. ROSS

Dr. Edgar S. Ross prepared for his active career in the petroleum industries at the University of New Hampshire and the University of Pittsburgh, where he specialized in the field of Chemical Engineering. After some years spent as a Research Fellow at the Mellon Institute he worked as chemist, manager of research and development, technical director and consultant.

At present Dr. Ross is connected with the Sun Oil Company as technical representative of the Industrial Products Division.

He is a frequent speaker and contributor to literature on technical subjects having to do with the practical utilization and application of petroleum products in industry and commerce, being particularly well known for activities in the fields of lubricants, liquid dielectrics and bituminous products.

He has a wide membership in national societies including the A.S.R.E., A.I.ChE., A.C.S., A.S.T.M., and the National Research Council. He is a member also of the Engineers' Club of Philadelphia and the Franklin Institute.

The officers whose photographs and biographies appear on these pages have been elected by the Directors, in accordance with the Constitution and By-Laws to carry on the work of the Society for the ensuing year.

New Committee Chairmen are listed on page 80.

Regional Vice Presidents have been elected to correlate local and sectional activities more closely.

The two directors named have been chosen from the Industrial Membership group, one to represent the users of lubricants, the other to represent the manufacturers.

# NEWS of the

## Cleveland-Youngstown Section

The March meeting of the Cleveland-Youngstown Section was held at the Cleveland Engineering Society with a good attendance.

Mr. Edwin Crankshaw of the Cleveland Graphite Bronze Company gave an interesting talk on "Trends in Sleeve Bearing Design." This talk was followed by a very spirited discussion.

The April meeting was held on the 23rd at the Cleveland Engineering Society with a three part program, the first part of which was concerned with an inspection trip through the Standard Oil Company's "Cat-Cracker," with dinner served at 6:30 and the meeting starting at 8 o'clock.

A very interesting talk was given by Mr. A. J. Jennings, Vice President of the Farval Corporation on "Centralized Systems of Lubrication." This talk has been now published and appears in this issue of LUBRICATION ENGINEERING. A very interesting question period followed the meeting.

It was announced that the Golf Party was scheduled for June 25th the Shady Hollow Country Club.

## Pittsburgh Section

The Pittsburgh Chapter held their regular monthly meeting on Friday, March 15, at the Webster Hall Hotel. Dinner was served to the sixty-nine who were present and several more dropped in later for the business session.

Due to the fact that the third Friday in April was Good Friday, it was decided to hold the regular April meeting on Friday, April 26. The entertainment committee verified the fact that a room would be available at Webster Hall for this meeting.

The membership committee reported that they have produced a pamphlet designed to be used in our drive to increase the membership. Mr. Lewis and Mr. Lempert also distributed letters that can be sent out with the membership brochures in an endeavor to interest new members in our society. They were extended a vote of thanks for the excellent preparation and thought that has gone into the production of these pieces of literature. Mr. W. C. Lewis, chairman of our local membership committee, was appointed a member of the national committee to obtain industrial memberships.

During the discussion that followed the report of the membership committee, it was agreed that badges showing the individual's name and affiliation should be provided for all regular members. Mr. C. S. Bullions of the Socony Vacuum Oil Company, stated that his company would supply the local section with these badges. Mr. Bullions and his company were given a rousing vote of thanks for this very kind offer.

Mr. Svenson then turned the meeting over to Mr. J. D. Lykins of the Wheeling Steel Corporation who gave a very informative and interesting discussion on the "Purification of Palm and Lubricating Oils." Mr. Lykins' talk was illustrated with slides giving very pertinent data. After Mr. Lykins' talk the meeting was thrown open for general discussion and much interest was shown in the information presented by Mr. Lykins.

## A.S.L.E. Section Officers

| | |
|---|---|
| CHICAGO: | Chair., Mr. W. F. Leonard, 4541 Sheridan Rd., Chicago, Ill.<br>V. Chair., Mr. D. N. Evans, Inland Steel Co., E. Chicago, Ind.<br>Secy.-Treas., Mr. R. Q. Sharpe, Socony-Vacuum Oil Co., 59 E. Van Buren St., Chicago, Ill. |
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| MILWAUKEE: | Chair., Mr. Oscar Frohman, Ampco Metal, Inc., 4478 N. Cramer St., Milwaukee 11, Wisconsin.<br>V. Chair., Mr. G. Radosevitch, Harnischfeger Corp., 1622 S. 13th St., Milwaukee 4, Wisc.<br>Secy., Mr. R. Ley, Shell Oil Co., 3240 S. Burrell St., Milwaukee 7, Wisc.<br>Treas., Mr. C. Beck, Globe Steel Tubes, 2958 N. 21st St., Milwaukee, Wisc. |
| NEW YORK: | Chair., Mr. D. D. Fuller, Dept. of Mech. Eng., Columbia Univ., New York 27, N. Y.<br>V. Chair., Mr. Henry Lee Norris, 600 W. 116th St., New York 27, N. Y.<br>Secy.-Treas., Mr. A. J. Zino, 27 Shoreview Rd., Manhasset, N. Y. |
| PHILADELPHIA: | Chair., Dr. Edgar S. Ross, Sun Oil Co., 1608 Walnut St., Philadelphia 3, Pa.<br>V. Chair., Mr. William P. Kuebler, Westinghouse Electric Corp., Philadelphia, Pa.<br>Secy.-Treas., Mr. J. H. Richards, Apex Alkali Prod. Co., Main & Rector Sts., Philadelphia 27, Pa. |
| PITTSBURGH: | Chair., Mr. E. B. Svenson, Sr., Aluminum Co. of America, New Kensington, Pa.<br>V. Chair., Mr. Mark A. Stillwagon, Carnegie-Illinois Steel Corp., Homestead, Pa.<br>Secy.-Treas., Mr. George H. Davis, Shell Oil Co., 1102 Grant Bldg., Pittsburgh, Pa. |

# SECTIONS

## Milwaukee Section

The February meeting of the Milwaukee Section was held on the 18th at the Schlitz Brown Bottle. The meeting was attended by over 100 people and was given over to the presentation of the subject "Greases" by Mr. D. W. Johnson, Manager of the Industrial Division of Standard Oil Company of Milwaukee.

This proved to be a highly interesting subject and from the amount of questions after the talk, a controversial subject, one which it would be well for all lubricating engineers to discuss more than is ordinarily done because greases, as a general rule, are taken just for granted.

"Stump the Experts" was the keynote of the April meeting of the Milwaukee Section. This adaptation from a popular radio feature proved to be highly interesting.

Invitations to attend the "Quiz" session were mailed with the request to submit questions on prepared cards. If the question submitted stumped the experts, the prize was 5 gallons of lubricating oil. The experts did not know the questions submitted until they were read by the "Quiz Master."

The stage setting was novel, to say the least. The panel of experts were grouped about a long draped table, each having a replica microphone initialed "A-S-L-E."

The "Quiz Master" was Mr. R. Ley, who handled the questions and also the experts with an iron hand.

The panel of experts consisted of: Mr. W. Winters, Mr. J. Wright, Mr. R. Schultz, Mr. W. Alexandroff, Mr. W. Schroeder.

The questions were very interesting and the answers—oh, the answers—were for the most part correct, but then again . . . A lot of good humor naturally crept into this program and since this necessarily had to be spontaneous, an atmosphere of friendliness was quickly created. The questions ran the whole length and breadth of lubrication—such as "Can 'quality' be written as a part of oil specifications"—"What properties can best be used to determine when an oil should be changed?"—"Name additives that will reduce the modulus of compressibility of an oil" and so on.

The experts had to pay off on several questions submitted, and since this "payoff" came out of their own pockets, it really hurt.

Definitely, we here in Milwaukee are planning to have at least one such session next fall.

The business section of our meeting concerned itself with a report of the Chicago meeting by Director G. Radosevitch, after which the election of Chapter Officers for the ensuing year took place with the following results:

Oscar Frohman, Ampco Metal, Inc., Chairman; G. Radosevitch, Harnischfeger Corp., Vice Chairman; R. Ley, Shell Oil Co., Secretary; C. Beck, Globe Steel Tubes, Treasurer; W. Alexandroff, Pate Oil Co., and A. Boie, Allis-Chalmers, Directors, 1 yr; W. Killiman, Milwaukee Road, and H. Kayser, Nordberg Corp., Directors, 2 yrs.

## New York Section

The New York Section held its March meeting on the 15th at the Shelton Hotel. There were more than 150 in attendance.

Papers were given by Mr. J. M. Russ of Carbide and Carbon Chemicals Corp., Mr. Kouppi of Dow Corning Company, and Mr. Edward G. Egan of Celanese Chemical Corp. An active discussion followed the presentation of the papers.

Thanks were expressed to Mr. Zino who arranged to have the McGraw Hill Hall available for the first meeting, and to Mr. Norris who made arrangements for the meeting at the Shelton Hotel.

Mr. Fuller mentioned that the By-Laws are being prepared, and it is hoped that these could be adopted at the May meeting.

## National Meeting

(*Continued from page* 75)

group of Sustaining Members. The Society was happy to welcome these two men on its governing board as it is felt their counsel will be of real value.

Among the many matters discussed at this meeting was the decision made to change the name of Sustaining Membership to Industrial Membership, as it is thought this latter name more truly represents the function which this class of membership should have. It is planned that Industrial Members, in addition to nominating an individual from a company to represent their membership, should receive additional copies of the magazine for distribution as may be desired and in every way receive the benefits of membership as would an individual member.

Tentative plans are being made for holding the next Convention in Pittsburgh, probably in the early spring of 1947.

## Lincoln Sales Manager Promoted

Jack L. Carmitcheal, formerly general sales manager, has been elected vice-president in charge of sales of the Lincoln Engineering Company, St. Louis, Missouri. The concern manufactures lubricating equipment for automotive, agricultural implements and industrial applications.

## Correction

Mr. R. F. McKibben, author of the paper entitled "Disc Voscometer," which appeared in the March issue, calls attention to an error in formula (12) on page 16, the formula should read:

$$\mu = 11{,}330\ W\,t$$

# NATIONAL COMMITTEES

## of

# THE AMERICAN SOCIETY OF LUBRICATION ENGINEERS

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## AMERICAN SOCIETY OF LUBRICATION ENGINEERS

### Grades of Membership

Membership in the Society is in several grades as defined below. Assignment to grade is made by the Admissions Committee or Board of Directors on the basis of information submitted or supplied by references.

### MEMBERS

Members shall be: (1) persons not less than twenty-four years in age who are engaged in research and instruction at technical schools, universities and various publicly and privately supported institutions in the field of lubrication; or (2) persons not less than twenty-four years in age who have occupied recognized positions as Lubrication Engineers for a period of three or more (not necessarily consecutive) years prior to date of admission, involving the responsibility for or supervision of the development, selection, field use and application of lubricants as differentiated from other activities; or (3) persons not less than twenty-four years in age who are indirectly concerned with the field of lubrication, but possessing other qualifications of experience, knowledge and accomplishment, have manifested a particular interest in the purposes and welfare of the Society, to the extent that their membership would be a valuable contribution to the successful functioning of its activities.

**$10.00**

### JUNIOR MEMBERS

Junior Members shall be: persons less than twenty-four years in age, and those who do not completely fulfill the membership requirements for Members.

**$5.00**

### INDUSTRIAL MEMBERS

Industrial members are such persons or organizations as may be interested in and desire to contribute to supporting the purposes and activities of the Society. The fees paid by an industrial member in general will not be allowed to exceed $200.00 per year.

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HE generally comes alone to see you. You called for him because something's gone wrong with a machine or process . . .

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¶ Made in seven distinctly different types and consistencies, each designed to meet a major group requirement for every important use of the lightest to the heaviest equipment for industrials and public utilities.

¶ Basically, these products are colloidal emulsions, high in adhesion and cohesion values. Some are free-flowing fluids, others of the emulsion type, in the degree determined by the oils and amounts of calcium base used.

¶ They WILL NOT SEPARATE. When subjected to temperatures approaching the flash point of the oil, they will return to their original body when cooled.

¶ The more fluid (oil) types will flow when in service. When idle, they become a colloidal gel, which forms a seal to openings and prevents leakage, and provide a grease coating on shafts and bearings for immediate lubrication on starting up of machine.

¶ "WHR" NONSEPARA (water-heat resistant). Designed to replace sodium and mixed base lubricants. Will not bleed, oxidize, harden, or dry out. Will maintain its lubricating qualities at over 400°F. (will not melt to a fluid) maintaining a buttery plasticity that, when at rest, will not seek its level at normal temperatures in a housing or sump, yet because of the adhesive-cohesive values, will function as a fluid. The lighter numbers will flow at zero.

●

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